22nd Annual Congress of the

EUROPEAN COLLEGE OF SPORT SCIENCE

5th - 8th July 2017, MetropolisRuhr – Germany

BOOK OF ABSTRACTS

Edited by:
Ferrauti, A., Platen, P., Grimminger-Seidensticker, E., Jaitner, T.,
Bartmus, U., Becher, L., De Marées, M., Mühlbauer, T.,
Schauerte, A., Wiewelhove, T., Tsolakidis, E.

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Welcome

Welcome to the 22nd Annual Congress of the ECSS

Welcome to MetropolisRuhr

On behalf of the European College of Sport Science and the University Alliance Ruhr, we welcome you to Essen for the 22nd Annual Congress of the ECSS.

The University Alliance Ruhr consists of three Universities: The Ruhr University Bochum, the TU Dortmund University, and the University of Duisburg-Essen. The Ruhr Area is not only Germany's largest academic hub, but also an epicentre of innovation that fosters close interaction between academia and the private sector. The University Alliance Ruhr offers a broad variety of cutting-edge research that transcends disciplinary borders and achieves international recognition. More than 110,000 students, of which 15,000 are international, as well as over 8,000 researchers study and work within the University Alliance Ruhr universities.

When combined, the Faculty of Sport Science at the Ruhr University Bochum, the Department of Sport and Sport Science at the TU Dortmund University, and the Institute of Sport and Movement Sciences of the University of Duisburg-Essen are one of the strongest places for Sport Science in Germany. Approximately 3,500 students follow a Bachelor or Master programme in Sport Science at one of the named universities. More than 15 professors are engaged in multiple research topics covering the areas of Physiology & Sports Medicine, Biomechanics & Neuromuscular, Social Sciences & Humanities, as well as Applied Training & Exercise Science.

Our conference topic "Sport Science in a Metropolitan Area" reflects the role of sport and physical activity in the Ruhr area, which is one of the largest multicultural urban agglomerations in the world and is heavily coined by industry. This environment results in tremendous sport scientific challenges, including the broad range from **Inactivity** to intense physical stress, the trend of increased **Individuality** in lifestyle and physical activity, as well as the **Inclusion** of minorities. Historically, some high-performance sports, such as professional football, have been an important factor to strengthen the people's **Identification** with our region. These topics will run as a thread through the congress and will be taken up by the four plenary sessions.

The ECSS MetropolisRuhr 2017 brings together people from all over the world, and provides a platform for an exchange of views and new research ideas. As young investigators are the future key-players in sport-scientific research, the ECSS MetropolisRuhr 2017 will specifically attract and warmly welcome highly motivated early stage researchers. We therefore provide instructional workshops and satellites, as well as several young investigator awards, and we initiated a new presentation format, the 1st ECSS Sport Science Slam.

Due to excellent submissions, we were able to build an outstanding scientific programme consisting of four plenary sessions and 37 invited and exchange symposia on current topical issues in the field of sport-scientific research. 1,750 abstracts have been submitted from 60 countries. 1,600 abstracts were selected for the final programme and were allocated to 112 oral, 41 mini-oral and 30 conventional poster sessions, or assigned to e-poster presentations. Out of these contributions, 61 oral and 25 mini-oral presentations were selected for the finals of the ECSS Young Investigators Award (YIA).

A congress is not only an opportunity for transfer of knowledge, but also a chance to grab the spirit of the hosting country and its people. In the area of MetropolisRuhr, there has been a huge transformation from an area of coal mining and steel production to a modern metropolis of the 21st century. Come and visit the famous "Grugapark" near to the Congress Center Essen (CCE) which is free of charge for congress participants. In this place, one can find a botanical garden with rare and beautiful plants, restaurants, bars, as well as a health facility and spa. It only takes you a mere five-minute-walk from the CCE and you are in the middle of the popular dining and nightlife area "Rüttenscheider Straße", where local pubs invite you to linger after a long and busy congress day. If you like to learn more about Germany, we will recommend you to visit the city of Cologne and other spots in the region of North-Rhine Westphalia. Just ask our volunteers who are pleased to assist you.

Enjoy the Congress, enjoy MetropolisRuhr!

Petra Platen & Alexander Ferrauti

Congress Presidents

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Wednesday, July 5th, 2017

12:00 - 13:30

Oral presentations

OP-PM03 Endurance and Performance

A COMPARISON OF DICARBONYL STRESS AND ADVANCED GLYCATION ENDPRODUCTS IN LIFELONG ENDURANCE ATHLETES VERSUS SEDENTARY CONTROLS

MAESSEN, M., SCHALKWIJK, C., VERHEGGEN, R., AENGEVAEREN, V., HOPMAN, M., EIJSVOGELS, T.
RADBOUDUMC

Introduction
Dicarbonyl stress and high concentrations of advanced glycation endproducts (AGEs) relate to an elevated risk for cardiovascular diseases (CVD). Exercise training lowers the risk for future CVD. We tested the hypothesis that lifelong endurance athletes have lower dicarbonyl stress and AGEs compared to sedentary controls and that these differences relate to a better cardiovascular health profile.
Methods
We included 18 lifelong endurance athletes (ATH, 61±7 years) and 18 sedentary controls (SED, 58±7 years) and measured circulating glyoxal (GO), methylglyoxal (MGO) and 3-deoxyglucosone (3DG) as markers of dicarbonyl stress. Furthermore, we measured serum levels of protein-bound AGEs Nε-(carboxymethyl)lysine (CML), Nε-(carboxyethyl)lysine (CEL), methylglyoxal-derived hydroimidazolone-1 (MG-H1), and pentosidine. Additionally, we measured cardiorespiratory fitness (VO2peak) and cardiovascular health markers.
Results
ATH had lower concentrations of MGO (196 [180-246] vs. 242 [207-292] nmol/mmol lysine, P=0.043) and 3DG (927 [868-972] vs. 1061 [982-1114] nmol/mmol lysine, P<0.01), but no GO compared to SED. ATH demonstrated higher concentrations CML and CEL compared to SED. Pentosidine did not differ across groups and MG-H1 was significantly lower in ATH compared to SED. Concentrations of MGO en 3DG were inversely correlated with cardiovascular health markers, whereas CML and CEL were positively correlated with VO2peak and cardiovascular health markers.
Discussion
Lifelong exercise training relates to lower dicarbonyl stress (MGO and 3DG) and the AGE MG-H1. The underlying mechanism and (clinical) relevance of higher CML and CEL concentrations among lifelong athletes warrants future research, since it conflicts with the idea that higher AGE concentrations relate to poor cardiovascular health outcomes.

DIETARY NITRATE SUPPLEMENTATION ATTENUATES PROGRESSIVE LOSS OF EFFICIENCY DURING PROLONGED MODERATE-INTENSITY EXERCISE

TAN, R., WYLIE, L., THOMPSON, C., BLACKWELL, J., BAILEY, S., VANHATALO, A., JONES, A.
UNIVERSITY OF EXETER

Introduction
During long-duration exercise bouts, plasma [nitrite] concentration may be substantially reduced such that the potential performance benefits of pre-exercise dietary nitrate supplementation, for example with beetroot juice (BR), may not be elicited. Consuming BR during prolonged exercise may help maintain plasma [nitrite], and thereby reduce the oxygen cost of exercise and enhance subsequent time-trial (TT) performance. Therefore, the aim of this study was to investigate whether 'topping up' with BR during 2-h of moderate-intensity exercise influences the oxygen cost of exercise and improves subsequent performance in a 4-km TT.
Methods
Following ethical approval, 9 recreationally-active males performed a 2-h moderate-intensity cycling bout followed by a 4-km TT in a double-blind, randomised, crossover design. Subjects were assigned to a 3-day supplementation period consuming 2 doses per day of BR (~6.2 mmol nitrate per 70 mL) or nitrate-depleted placebo (~0.04 mmol nitrate per 70 mL) with a 5 day wash-out period, and underwent 3 conditions: 1) nitrate supplementation before and 1-h into exercise (BR+BR); 2) nitrate supplementation before and placebo 1-h into exercise (BR+PL); and 3) placebo before and 1-h into exercise (PL). Oxygen uptake ($\dot{V}O_2$) was measured throughout exercise. Muscle biopsies, which were taken at rest, 2-h and post-TT were being analysed at the time of abstract submission. Differences between conditions were analysed using a two-way repeated measures ANOVAs.
Results
Mean $\dot{V}O_2$ across 2-h was lower in BR+BR (1.73 ± 0.22 L min-1) and BR+PL (1.74 ± 0.21 L min-1) compared to PL (1.78 ± 0.22 L min-1; P<0.05). $\dot{V}O_2$ was not different between conditions at 0, 30, 60, and 90 min, but $\dot{V}O_2$ at 120 min was lower in BR+BR (1.78 ± 0.38 L min-1) compared to BR+PL (1.86 ± 0.34 L min-1) and PL (1.90 ± 0.39 L min-1; P<0.05). The TT completion time did not differ between conditions (BR+BR: 7.29 ± 2.24 vs. BR+PL: 7.31 ± 2.22 vs. PL: 7.08 ± 2.16 min; P>0.05) and there were no differences in $\dot{V}O_2$ during the TT (all P>0.05). However, the change in power-to-$\dot{V}O_2$ ratio from 1km to 4km decreased to a lesser extent in BR+BR (-25 ± 23 W L min-1) compared to PL only (-53 ± 31 W L min-1; P=0.05).
Discussion
BR supplementation before exercise reduced the oxygen cost of exercise compared to placebo, and 'topping-up' with BR during prolonged moderate-intensity exercise resulted in a further reduction in oxygen cost at 120 min compared to pre-exercise ingestion alone. Improved efficiency during prolonged exercise, which may derive from reduced ATP cost of force production, may be expected to spare muscle glycogen. Although the BR top-up protocol was not ergogenic in the subsequent 4-km TT, these data suggest that nitrate ingestion may modulate substrate utilisation and efficiency in events lasting >2-h.
Contact: rt354@exeter.ac.uk

HOW DO ELITE CYCLISTS COMBINE HIGH SPRINT AND ENDURANCE PERFORMANCE?

VAN DER ZWAARD, S., WEIDE, G., VAN DER LAARSE, W.J., DE KONING, J.J., BLOEMERS, F.W., DE RUITER, C.J., JASPERS, R.T.
VRIJE UNIVERSITEIT AMSTERDAM

Introduction
In many sports, athletes need to combine high sprint and endurance performance. However, this is challenging as muscle fiber cross-sectional area and muscle fiber VO2max are inversely related. To identify critical determinants of a high sprint and endurance performance. To this end, we investigated how sprint and endurance performance are related in elite road and track cyclists and assessed to what extent their sprint and endurance performance are determined by muscle morphology and muscle fiber physiology.
Methods
Twenty-eight male cyclists (24 competed at the (inter)national or Olympic level) performed a 15km time trial to assess endurance performance (mean power output, POTT) and a 30-s Wingate test to assess sprint performance (peak power output, POpeak). O2 consumption was averaged over the time trial (VO2TT). Morphology of m. vastus lateralis (VL) (i.e. volume, physiological cross-sectional area (PCSA), fascicle length (Lf) and pennation angle) was derived from a 3D ultrasound reconstructed voxel array. Muscle fiber physiology of VL (fiber type, fiber cross-sectional area, fiber VO2max, [myoglobin (Mb)] and capillary-to-fiber ratio (C/F)) were obtained using muscle biopsy histochemistry. To combine endurance and sprint performance, POTT and POpeak were converted to Z-scores and summated. Pearson correlations and multiple stepwise regressions were performed.
Results
Cyclists showed high POpeak (1327±197 W [993-1685]) and high POTT (344±52 W [233-431]). Nevertheless, POpeak and POTT per kg body mass were inversely related ($r=-0.44$, $p<0.05$). Sprint performance was explained by VL volume + fiber type II ($R2=0.72$, $p<0.001$). Endurance performance was strongly related to VO2TT ($r2=0.86$, $p<0.001$). Combined sprint and endurance performance was determined by VL volume + fiber type II + VO2TT ($R2=0.80$, $p<0.001$). In addition, VO2TT was explained by fiber VO2max + Mb*C/F + Lf ($R2=0.69$, $p<0.001$).
Discussion
Combining high sprint with high endurance cycling performance is challenging, as illustrated by their inverse relationship ($r=-0.44$). Despite this challenge, elite cyclists are able to achieve high sprint with high endurance performance by combining expression of fast myosin heavy chain (fiber type II), high oxidative capacity (fiber VO2max), well-developed O2 supply (Mb*C/F) and a large muscle volume composed of long fascicles rather than a large PCSA. The integrative assessment of an athlete's muscle morphology and muscle fiber physiology may be useful for identification of critical success factors for performance and for individualization of training strategies.
Funding
STW

INFLUENCE OF LIGHT EXPOSURES ON CYCLING PERFORMANCE AND MELATONIN LEVELS IN MALE ELITE ENDURANCE ATHLETES – A DOUBLE-BLIND RANDOMIZED CONTROLLED TRIAL

KNAIER, R.1, SCHÄFER, J.1, ROSSMEISSL, A.1, KLENK, C.1, HANSSEN, H.1, CAJOCHEN, C.2, SCHMIDT-TRUCKSÄSS, A.1
1:UNIVERSITY OF BASEL, 2:PSYCHIATRIC HOSPITAL OF THE UNIVERSITY OF BASEL

Introduction
Light exposure can increase alertness, reduce melatonin levels (Cajochen, 2007) and shift the circadian rhythm, which are all suspected causes for a performance decrease in the evening. We have previously shown that light exposure can improve cycling performance in a positive dose-response relationship (Knaier et al., 2015). The purpose of this trial was to assess the effect of different light exposure modalities on cycling performance and melatonin levels. This was done in the late evening, a time when sport events often take place, but when many athletes have already exceeded their time of peak performance (Facer-Childs et al., 2015).
Methods
Male athletes performed a cardiorespiratory fitness test on a bicycle ergometer and were then randomly assigned to either bright light (BRIGHT), blue monochromatic light (BLUE), or control light (CONTROL). Seven days later, a 12-minute all-out time trial was performed immediately after a 60-minute light exposure which started 17 hours after each individual's midpoint of sleep (median time: 9:17 pm) to examine all participants at the same internal time. Multivariate analysis with adjustment for VO2max was used to evaluate differences in work performed during the time trial between the groups.
Results
The median VO2max of the 69 participants was 63 ml/kg/min. The adjusted difference in work performed was 4.1 kJ (95% confidence interval [CI] -4.5, 12.7) for participants in BRIGHT and -1.2 kJ (95% CI -9.8, 7.5) for participants in BLUE, both relative to participants in CONTROL. However, a tenfold increase in exposure to non-image forming light was associated with a melatonin decrease of -0.9 pg/ml (95% CI -1.5, -0.3) and a performance gain during the time trial of 6.2% (95% CI: 1.3, 11.1).
Discussion
Exposure to bright or blue light did not significantly improve maximum cycling performance in a 12-minute all-out time trial. However, it is noteworthy that the estimated difference of 4.1 kJ between BRIGHT and CONTROL might present an important advantage justifying further studies. In conclusion, we found first evidence that evening light exposure, which strongly activates the human circadian timing system, enables elite athletes to remain longer at high daytime performance levels resulting in an advantage in similar competitions.

MUSCULOSKELETAL CHARACTERISTICS FOR ELITE DISTANCE RUNNERS AND NON-COMPETITIVE KENYANS

KUNIMASA, Y.1, SANO, K.1, HISANO, T.1, MAKINO, A.1, ODA, T.2, NICOL, C.3, KOMI, P.V.4, ISHIKAWA, M.1
1: OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES (OSAKA, JAPAN), 2: HYOGO UNIVERSITY OF TEACHER EDUCATION (HYOGO, JAPAN), 3: AIX-MARSEILLE UNIVERSITÉ (MARSEILLE, FRANCE), 4: NMRC AND LIKES RESEARCH CE

Introduction
It has been explored whether certain traits that are acquired through genetic and/or environmental factors can be related to the disproportionate success of the elite-level Kenyan runners in long distance running events. Our previous studies reported that elite-level Kenyan distance runners possess the specific musculoskeletal structures of lower-legs which are related to the endurance running performance (Kunimasa et al 2014; Sano et al 2015). However, it remains questionable whether their specific musculoskeletal characteristics of lower-legs are acquired through genetic and/or environmental factors. Therefore, the purpose of the present study was twofold: 1) to examine

the differences of musculoskeletal characteristics of lower-leg between world-class elite runners, national level runners and non-competitive adults in Kenya; and 2) to examine those between different age groups for non-competitive Kenyan and Japanese. It was hypothesized that the specific long Achilles tendon and its moment arm for elite-level Kenyan runners are similar to those for Kenyan in general population, but length of muscle fascicles can be different as the age group increases.
Methods
Eighteen world-class elite runners, 34 national level runners and 34 non-competitive adults in Kenya participated in this study. In addition, non-competitive 216 Kenyans and 386 Japanese from children to young adults (4-30 years) were also recruited for comparison between Kenyan and Japanese general population. Using ultrasonography, the following parameters were measured: Achilles tendon length (LAT) and its moment arm length (MAAT), medial gastrocnemius muscle (MG) fascicle length (LMG).
Results
All measured parameters did not show any significant differences between world-class elite runners, national level runners and non-competitive adults in Kenya. In comparison between Kenyans and Japanese general population, LAT was significantly longer in Kenyans than in Japanese in each age group. LMG and MAAT in Kenyans after the early childhood were significantly shorter and longer than in Japanese, respectively. However, both parameters in the early childhood did not show any significant differences between Kenyans and Japanese.
Discussion
These results clearly suggest that the specific musculoskeletal characteristics of lower-leg for elite-level Kenyan runners as compared to those athletes from other countries can be common feature among Kenyans rather than the results of the specific training adaptation of elite-level Kenyan runners. The specific LMG and MAAT in Kenyans can be characterized in the growth process of childhood.
References
Kunimasa Y et al (2014) Scand J Med Sci Sports. 24: e269-274.
Sano K et al (2015) Eur J Appl Physiol. 115: 849-859.
Contact
yoko.kunimasa@gmail.com

EFFECT OF DIFFERENT MORNING PRIMING EXERCISES ON AFTERNOON PERFORMANCE IN ROAD CYCLISTS

DONGHI, F.1, BOSIO, A.1, RAMPININI, E.1, MORELLI, A.1, INDUNI, M.1, MAFFIULETTI, N.A.2
1MAPEI SPORT RESEARCH CENTRE, OLGIATE OLONA, ITALY. 2SCHULTHESS CLINIC, ZURICH, SWITZERLAND.

Introduction
Success in cycling time trial (TT) may be a matter of few seconds, therefore strategies aimed at improving performance on race day are paramount. Repeated sprint running completed in the morning has been proposed as one of the most effective strategies to improve PM sprinting performance and to attenuate the circadian reduction of testosterone (T) in rugby players (Russel et al., 2016). The aim of this study was to investigate the effect of different AM priming cycling exercises on PM endurance and muscular performance in road cyclists.
Methods
Twelve cyclists (age 20±1 yrs, height 177±5 cm, weight 64±6 kg, VO2max 69±7 ml.kg-1.min-1) participated to a randomized counterbalanced crossover study. They completed 3 different conditions separated at least by 48 h: repeated sprint cycling (RSC, 6x6-s sprints, 20 s rec), ecological exercise (ECO, 10 min progression to anaerobic threshold + 5 min intermittent phase + 2x6-s sprint; total time ~30 min including recovery) and a control condition (CON) with no exercise. Blood T, blood cortisol (C) and body temperature (BT) were assessed twice every day at 8:30 am and at 1:30 pm. Maximal voluntary contraction (MVC), voluntary activation (VA), rate of torque development (RFD) and evoked contractile properties (ECP) of knee extensor muscles as well as 6-s cycle sprint performance were evaluated in AM before exercise protocols and in PM before the 5 km TT. Rate of perceived exertion (RPE), self-reported mood state (BRUMS), motivation (DSSQ) and feeling state (FS) were also assessed.
Results
The RPE was most likely higher for RSC and ECO compared to CON (5.2±1.4, 5.5±2.0, 3.0±1.2). Compared to CON, RSC induced a possibly negative effect on ECP (-3%), RFD (-6.7%) and possibly positive effects on C (+9.3%), VA (+2.0%), sprint (+2.5%) but no considerable effect on TT time (-0.6%). Task-independent motivation before TT was likely higher (+5.5%) but FS after TT was possibly lower (-0.3 au) for RSC than for CON. The ECO condition induced a possibly positive effect on MVC (+2.1%), VA (+2.3%), ECP (+4%) and TT time (-1.3%) compared to CON, despite a likely positive effect on self-reported fatigue (+52.6%). FS after TT resulted possibly higher (+0.4 au) compared to CON. No substantial effect was observed on T and BT after both RSC and ECO.
Discussion
Despite higher self-reported fatigue and lower motivation before the TT, the ECO condition might be a good strategy to possibly improve PM endurance performance. Unexpectedly, RSC exercise might possibly improve PM sprint performance, even if there was no substantial effect on T in our study and ECP were even impaired.
References
Russel, M et al., (2016). Int J Sports Physiol Perform; 11:763-767.
Contact
federico.donghi@gmail.com

Oral presentations

OP-PM02 Aspetar Football Science Award

BETTER MATCH PHYSICAL PERFORMANCE ACHIEVED IN PROFESSIONAL FOOTBALL WITH HIGHER VARIABILITY DURING TRAINING: A MACHINE-LEARNING APPROACH

FERNÁNDEZ, J., MEDINA, D., GÓMEZ, A., ARIAS, M., GAVALDÀ, R.

F.C. BARCELONA

Introduction
The 'Barça structured training' method involves simulating multiple team-sport specific situations to expose the player to a varied training stimulus. The increased training variability is believed to enhance physical performance during football competition. The purpose of the present study was to investigate how the degree of variability in training influenced player physical performance during matches using a clustering algorithm and statistical test approach.
Methods
Physical performance data was gathered from 25 male professional football players of Barça B team during one season, including 153 training sessions and 34 matches, and using STATSports Viper pods. 9 variables were identified: distance (DIS), number of sprints (SPR), max speed (MAX), high metabolic load distance (HML), high metabolic efforts (HEF), relative metabolic power (PER), dynamic stress load (DSL), total loading (TLO) and accelerations (ACC). Variability was calculated by dividing the mean session value by the standard deviation of the microcycle, for each given variable and player. A dataset was created by grouping the variability of 3 week microcycles, including training and matches. From this dataset, K-Means clustering was applied to group the microcycle variability in an optimal number of clusters. Physical performance of each player during matches following each the microcycle was labelled respectively. For both clustered training groups and matches groups, independent t-test were performed and the standardized difference of means was assessed.
Results
Of the 9 variables in the training groups, very large effect sizes (ES > 2.0) were found for DIS (ES=2.1, p<0.001), PER (ES=2.2, p<0.001) and TLO (ES=2.4, p<0.001); large ES (1.2< ES <=2.0) for DSL (ES=1.9, p<0.001), HEF (ES=1.9, p<0.001) and SPR (ES=1.3, p<0.001); and moderate ES (0.6< ES <=1.2, p<0.1) for ACC (ES=0.64, p=0.01), HML (ES=1.16, p<0.001) and MAX (ES=0.81, p<0.001). Cluster analysis showed high variation and low variation groups. The high variation group presented higher physical values in matches, showing moderate ES for PER (ES=1.14, p<0.001), TLO (ES=0.72, p<0.001), DIS (ES=0.77, p<0.001), HEF (ES=0.7, p<0.001) and HML (ES=0.68, p<0.001); and small ES (0.2< ES <=0.6) for ACC (ES=0.40, p=0.066) and DSL (ES=0.44, p<0.001).
Discussion
In conclusion, training involving high variation, was associated with significantly superior physical performance during matches, in comparison to low variation training. Training variation in microcycles can be classified as 'high' or 'low' based on those variables identified in the present study. Understanding of the relationship between training variability and match physical performance allows an objective assessment of training practice in football.
Contact
javier.fernandez@pl.fcbarcelona.cat

THE EFFECT OF IN-GAME FOOTBALL COOLING STRATEGIES UPON CORE TEMPERATURE

CHALMERS, S.1, LOVELL, R.1, SIEGLER, J.1, MARSHALL, P.1, GREGSON, W.2, JAY, O.3

1: WESTERN SYDNEY UNIVERSITY (AUSTRALIA), 2: ASPIRE ACADEMY (QATAR), 3: UNIVERSITY OF SYDNEY (AUSTRALIA).

Introduction
Football (soccer) is a worldwide sport that includes competition in hot environments that have an inherent risk of heat illness. The potentially fatal nature of heat illness warrants precautionary measures that mitigate risk. Brief 3-min cooling periods were implemented at the midpoint of each half during 2014 World Cup games undertaken in very hot conditions. Breaks in activity theoretically slow the rise in core temperature over the course of a match, thereby enhancing player safety by reducing the risk of heat illness. However, whether brief cooling breaks can successfully mitigate heat strain in a football-specific context has not yet been assessed.
Methods
Eight semi-professional male football players (age: 22 ± 1 years, VO2max: 57 ± 3 ml/kg/min) completed four standardised treadmill match simulation trials in hot/humid conditions (30°C WBGT, 35°C ambient, 55% relative humidity). The four trials were: 1) regular game (CON); 2) regular game with 2x3-min cooling periods inclusive of cool water (COOLwater); 3) regular game with 2x3-min cooling periods inclusive of cool water and an ice-towel around the neck (COOLtowel); 4) regular game with an extended (20-min [instead of 15-min]) half-time break (HTextended). The 3min cooling periods occurred at the 30-min stage of each half and the total match time was 90-min. Rectal temperature (Tre) and heart rate (HR) were continuously monitored during each trial. A statistical spreadsheet was used to calculate magnitude-based inferences between trials and 95% confidence intervals were reported.
Results
The total change in Tre (0 to 90-min of match time) was: CON 2.30°C (1.97 to 2.63°C), COOLwater 1.94°C (1.73 to 2.16°C), COOLtowel 2.03°C (1.73 to 2.33°C), and HTextended 2.07°C (1.73 to 2.40°C). Relative to CON, there was a 'likely large' cooling effect in COOLwater trial (-0.36 [-0.59 to -0.12] °C), a 'likely moderate' cooling effect in COOLtowel trial (-0.27 [-0.54 to 0.00] °C), and a 'likely moderate' cooling effect in HTextended trial (-0.23 [-0.41 to -0.05] °C) for total Tre change. The difference in match HR relative to CON was, 'very likely moderate' beneficial effect in COOLwater (-12 [-17 to -7] bpm), a 'likely moderate' beneficial effect in COOLtowel (-8 [-14 to -2] bpm), and a 'likely small' beneficial effect in HTextended (-5 [-9 to 0] bpm).
Discussion
Brief 3-min cooling break interventions or an extended half-time period all mitigated the rise in Tre, and theoretically the risk of heat illness, compared to a control game. Our data indicate that a 3-min in-game break during each half in which cool water is ingested elicits the greatest cooling effect.
Contact
samuel.chalmers@westernsydney.edu.au

PERFORMANCE, PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF ADDITIONAL COGNITIVE WORKLOAD DURING SMALL-SIDED SOCCER GAMES

BOSIO, A.1, BIZZI, M.1, RAMPININI, E.1, RIGGIO, M.1, CONNOLLY, D.2, MARCORA, S.3

MAPEI SPORT RESEARCH CENTRE

Introduction
Adding cognitive workload to training may lead to improvements in physical endurance and better resistance to mental fatigue (Brain Endurance Training, BET). Before testing these hypotheses in soccer players, we tested the effects of a practical intervention aimed at adding cognitive workload during small-sided soccer games (SSG). Specifically we wanted to investigate whether this intervention 1) reduces the amount of physical work and physiological stress, 2) increases perceived workload and 3) induces mental fatigue.
Methods
Forty young soccer players took part in this randomized crossover study. On 3 different days participants played 4x4min (4'30" rec) 5vs5 SSG. Passive recovery was observed during control condition (CON) while a 3min demanding computer-based cognitive task was carried out during recovery in experimental condition (EXP). On one occasion both teams were under CON, in the other two cases one team was under CON and the other EXP. Before SSG, motivation, mood and cognitive performance were assessed. At the end of the last SSG mood, subjective workload, cognitive performance, session-RPE were assessed. Physical activity profiles (GPS) and heart rate were monitored; SSG were video recorded for notational analysis of technical variables. Players rated RPE at the end of each SSG. Statistical analysis (ANOVA, t-test) was performed only for CON-CON and EXP-CON combinations.
Results
The additional cognitive workload during SSG did not significantly affect physical activity profiles, heart rate or technical variables. However, RPE at the end of each SSG (main effect of condition, $p<0.001$) and session RPE ($p=0.031$) were shown to be higher in EXP (5.8±1.3 a.u.) compared to CON (5.3±1.1 a.u.). The additional cognitive workload also induced a significant reduction in cognitive performance in EXP compared to CON which indicates a higher degree of mental fatigue. No significant effects of condition were found on other subjective measures of fatigue, workload, and on motivation.
Discussion
These findings show that performing demanding computerized cognitive tasks during the recovery periods of SSG is feasible, increases perceived workload, and induces mental fatigue. Interestingly, this was possible without any significant reduction in the amount of physical work and physiological stress during SSG. Future training studies should investigate whether this soccer-specific form of BET can induce chronic improvements in physical endurance and resistance to mental fatigue in soccer players.
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Contact
andrea.bosio@mapeisport.it

MULTIVARIATE MODELLING OF NON-CONTACT INJURY RISK IN ELITE AUSTRALIAN FOOTBALLERS

COLBY, M., DAWSON, B., PEELING, P., HEASMAN, J., ROGALSKI, B., STARES, J., ZOUHAL, H., LESTER, L.

THE UNIVERSITY OF WESTERN AUSTRALIA

Introduction
The determination of each player's injury risk at the start of the training week, through the assessment of various sport-specific risk factors, is critical to enhance injury prevention in elite Australian football. The purpose of this study was to identify the association between workload, subjective wellness, musculoskeletal screening measures and non-contact injury risk in elite Australian footballers.
Methods
Weekly workload metrics [internal; session rating of perceived exertion (sRPE), external; GPS distance, sprint distance] were calculated as the acute (1 week), chronic (2-4 weeks) and acute: chronic workload ratio (ACWR: 1-week load divided by average 4- week load). In addition, weekly subjective wellness ratings, musculoskeletal screening and non-contact injury data, were collected from 70 players from one AFL club over 4 seasons. All variables were first modelled independently. Significant variables, plus those shown to improve model fit, were then entered into a multivariate model to determine the best combination of factors associated with injury risk. Poisson regression with robust errors within a General Estimating Equation were utilised to determine injury incidence rate ratios (IRR).
Results
Independently modelled, very low chronic (2-4 week) workloads were associated with greater injury risk (IRR= 1.71-2.16). When accounted for in the multivariate model, a very-low (i.e. a significant training de-load; IRR= 2.06) and high sprint distance ACWR (IRR= 2.21) was associated with increased injury risk. Players subjectively (yes/no) reporting old lower limb pain in the previous 7 days were also associated with increased injury risk (IRR= 2.48). A 1 standard deviation drop in an individual's weekly musculoskeletal screening score did not improve model accuracy.
Discussion
These findings highlight the importance of multivariate modelling to account for confounding and/or interaction effects. A very-low sprint ACWR may predispose a player to a subsequent acute spike in sessional sprint distance or decrease their chronic load foundation, thus increasing injury risk. A player's chronic load foundation plays an important role in the workload-injury relationship, and should be factored into multivariate analyses.

SCHEDULING OF INJURY PREVENTION EXERCISES DURING THE SOCCER MICRO-CYCLE: INSIGHTS FROM MUSCLE DAMAGE, SORENESS AND PERFORMANCE RECOVERY PROFILES

LOVELL, R., WHALAN, M., SAMPSON, J., MARSHALL, P., SIEGLER, J., BUCHHEIT, M.

WESTERN SYDNEY UNIVERSITY

Introduction
Eccentric based injury prevention exercises are considered essential to reduce the risk of the most common soccer injuries. Yet, scheduling these exercises during the common 7-day micro-cycle is challenged by recovery and tapering phases. The aim of this study was to

profile muscle damage, neuromuscular performance, and perceptual responses to an eccentric-based injury prevention program (IPP) administered 1 (MD+1) versus 3 days (MD+3) post-match.
Methods
18 semi-professional players (Age 23 ± 4 years; body mass: 74.5 ± 11.3 kg; stature 178.4 ± 8.7 cm) were monitored daily during 3 in-season 7-day micro-cycles including weekly competitive fixtures. Knee flexor isometric force (PF), counter-movement jump (CMJ) performance, muscle soreness and capillary creatine kinase concentration (CK) were assessed 24 h prior to match-day (MD-1), and 24 (MD+1), 48 (MD+2), 72 (MD+3), 96 (MD+4) and 120 h (MD+5) post-match. Internal training loads were determined via sRPE. The IPP consisted of lunges, single leg bend-over with 6 kg kettle-bell, single leg-lowers (all 4 x 5 repetitions on each limb) and nordic hamstring exercises on a bosu-ball (4 x 5 repetitions). In a cross-over design, players performed the IPP either on MD+1 or MD+3, or not at all (CON), during three micro-cycle schedules, administered in a randomized order. Magnitude-based inferences were calculated from linear-mixed model generated estimated marginal means (adjusted for sRPE). Data are expressed as mean % changes from MD-1, 90% confidence intervals (CI).
Results
Performing the IPP on MD+1 attenuated the decline in CK at MD+2 (+61%; CI: 38-89%) normally observed following match-play (CON: +32%; CI: 12-55%; MD+3: +51%; CI: 29-77%; small-moderate effects). When IPP was delivered on MD+3, CK was higher versus CON and MD+1 trials on both MD+4 (MD+3: +131%; CI: 95-174%; CON: +33%; CI: 11-59%; MD+1: +34%; CI: 14-58%; moderate effects) and MD+5 (MD+3: +88%; CI: 60-121%; CON: +15%; CI: -3 to 36%; MD+1: +8%; CI: -8 to 27%; small to moderate effects). Hamstring and quadriceps soreness was not exacerbated beyond CON when the IPP was delivered on MD+1, but when prescribed on MD+3, soreness ratings remained higher on MD+4 and MD+5 (small effects). No between trial effects were observed for PF and CMJ.
Discussion
Administering the IPP in the middle of the micro-cycle (MD+3) increased measures of muscle damage and soreness, which remained elevated on the day prior to the next match (MD+5). Accordingly, IPP should be scheduled early in the micro-cycle, to avoid compromising preparation for the following match.
Contact
R.Lovell@westernsydney.edu.au

Oral presentations

OP-PM61 Cardiovascular effects of exercise

LINKAGE BETWEEN HEART RATE KINETICS AND CARDIOVASCULAR CONTROL DURING ORTHOSTATIC STRESS

KOSCHATE, J.1, WERNER, A.2, THIESCHAEFER, L.1, DRESCHER, U.1, HOFFMANN, U.1

1: GERMAN SPORT UNIVERSITY COLOGNE (GERMANY), 2: CENTRE OF AEROSPACE MEDICINE, GERMAN AIR FORCE (GERMANY)

Introduction
Orthostatic intolerance is related to aerobic capacity (Levine et al. 1991). Therefore, regulatory processes of the cardiovascular system (e.g. perfusion kinetics) should be investigated regarding both, orthostatic stress (OS) as well as adaptations to changes in metabolic demands. It was tested, whether heart rate (HR) kinetics determined during a cycle ergometry test, are linked to the adjustments of the cardiovascular system to increased OS.
Methods
14 male subjects (age: 30 ± 4 years, body height: 179 ± 8 cm, body mass: 79 ± 8 kg) performed a work rate (WR) protocol, comprising a constant phase of 30 W, randomized switchings between 30 and 80 W and a constant phase of 80 W on a cycle ergometer. To assess HR kinetics, cross-correlation functions between WR and HR were calculated. Higher maxima in cross-correlation functions (CCFmax) between the WR protocol and HR, denote faster kinetics (Hoffmann et al. 2013). Additionally, all subjects were tilted four times on a tilt table from 65° to 90° (25 s) to -6° (22 s), to 90° (25 s) and back to 65° to investigate the cardiovascular responses to changing OS. During both tests, HR and mean arterial blood pressure (MAP) were measured beat-to-beat. Stroke volume (SV) was calculated from the pulse waves and total peripheral resistance (TPR) was then computed from SV, HR and MAP. Differences in HR, MAP, SV and TPR from -6° to 90° tilts (tilt-up) and mean HRs during the 30 W and 80 W constant phases were calculated. Correlation coefficients were computed and tested via two-tailed hypotheses.
Results
CCFmax(HR) was significantly correlated with the changes in HR during tilt-up ($r=0.667$, $P=0.009$) and the difference in HR from 30 W to 80 W during the cycle ergometer test ($r=-0.574$, $P=0.032$). The changes in HR during tilt-up were correlated with low significance to the changes in TPR ($r=-0.485$, $P=0.079$) and TPR correlated with the changes in MAP ($r=0.651$, $P=0.012$).
Discussion
The data suggest that smaller increases in HR at submaximal WRs and in response to OS are accompanied by faster HR kinetics. Additionally, a lower increase in HR during tilt-up was linked to a minor decrease in TPR, which in turn was related to a smaller decrease in MAP. Therefore, HR kinetics determined during exercise are linked to the cardiovascular responses to OS. Faster HR kinetics, in synergy with the changes in HR, MAP and TPR during tilt-up, can be considered as an indicator of orthostatic tolerance.
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MIXED-EFFECTS MODELLING OF HEART RATE VARIABILITY INDICES IN ELITE SWIMMERS

PERERA-LLUNA, A.1, HITA, A.1, CAMINAL, P.1, CHAVERRI, D.2, IGLESIAS, X.2, RODRÍGUEZ, F.A.2

UNIVERSITAT POLITÈCNICA DE CATALUNYA (1) AND UNIVERSITAT DE BARCELONA - INEFC (2)

Introduction
Heart rate variability (HRV) has the potential to illustrate adaptations to training and the environment (Koenig et al. 2014). This study characterizes the HRV response to 3 weeks of high-load training at sea level (SL) vs. moderate altitude (ALT) by modelling the time evolution of HRV indices using a longitudinal, mixed-effects analysis design.
Methods
Twenty-eight elite swimmers completed a 3-week high-load training block at SL (Lo group, n=11) or at 2320 m of ALT (Hi group, n=17). Training load was quantified using the cummulative training impulse (TRIMPc) (Garcia-Ramos et al. 2015). RR-intervals were recorded every morning in supine (SU, 8 min) and orthostatic (OR, 6 min) positions. 27 HRV indices were derived from the last 5-min period in both positions (Kubios HRV, Finland) for time domain, frequency domain (FFT transformation), and non-linear analysis (Poincaré plot analysis, approximate and sample entropy, recurrence plot parameters, detrended fluctuation analysis, and correlation dimension parameters). Differential variables (OR-SU) were also calculated. Generalized mixed effects models (GLMM) were fitted to data for estimating the effect magnitude of training on the HRV normal and lognormal link functions. R was used for all calculus and to contrast the differential effects ($p<=0.05$).
Results
1) Time domain: There was no association between HRV indices and accumulated training in SU, while OR elicited such association and differential effects between groups; 2) Frequency domain: Accumulated training had a strong impact on these indexes. At OR, the effect on both low (LF) and high frequency (HF) bands was positive in Hi but negative in Lo. LF/HF behave similarly in both groups, but the effect was two-fold greater at OR; 3) Poincaré plot: At OR, both axes decreased with training in Lo while increasing in Hi; 4) Recurrence plot: Training effects were found in differential indexes in Lo only. 5) Others: All correlation and sample entropies indexes slightly increased in Lo.
Discussion
GLMM coefficients confirmed remarkable changes of HRV in response to training and hypoxia. They also highlighted the differences existing on the autonomous nervous system regulation mechanisms depending on training conditions, as major differences were observed between body position during measurements (OR vs. SU) and the environment (ALT vs. SL). GLMM allowed estimating unbiased weights by balancing different swimmers' HRV baseline with the incorporation of a random effect describing such baseline and by allowing the most suitable response variable error distribution to linearly vary with the explanatory variables.
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Contact
farodriguez@gencat.cat

PHYSICAL TRAINING PROMOTES SIMILAR EFFECTS TO THE BLOCKADE OF ANGIOTENSIN-CONVERTING ENZYME ON THE CARDIAC MORPHOLOGY AND FUNCTION IN OLD FEMALE RATS SUBJECTED TO PREMATURE OVARIAN FAILURE

SOUZA, H., FELIX, A.C.S.

RIBEIRÃO PRETO MEDICAL SCHOOL, UNIVERSITY OF SAO PAULO

Introduction
We investigated the effects of angiotensin-converting enzyme (ACE) inhibition and aerobic physical training on the heart of old female rats (82-wk-old) submitted to premature ovarian failure (10-wk-old).
Methods
We used different approaches: morphology and function by echocardiography, reactivity of the coronary bed and left ventricular contractibility (Langendorff Technique). Female Wistar ovariectomized (OVX) rats (n=42) were assigned to one of four groups: OVX, vehicle treated only; OVX-EM, Enalapril Maleate only (EM, 10mg.kg-1.d-1); OVX-T, aerobic trained only; and OVX-EMT, treated with Enalapril Maleate and aerobic trained. Both Enalapril Maleate treatment and aerobic training were done in the last 20 weeks of the experimental protocol.
Results
When compared to the OVX group, the OVX-EM group showed lower values of wall thickness and left ventricular (LV) mass, lower values of coronary bed reactivity and reduced maximum response of LV contractility to dobutamine, while the OVX-T group showed lower values of LV wall thickness, increase in end-systolic volume, reduced maximum response of LV contractility to dobutamine, and left intraventricular pressure due to increased flow. The combination of treatments (EM and aerobic physical training) did not promote additional important effects on the parameters evaluated.
Discussion
Our results suggest similar beneficial effects of physical training and EM treatment on the morphology and cardiac function in old female rats submitted to premature ovarian failure. Although the causes of these benefits are still unknown, both treatments have promoted a decrease in cardiac contractility, and the reduced β1-adrenergic sensitivity suggests that both treatments may attenuate the sympathetic effect on the heart.

THE EFFECT OF SEDENTARY BEHAVIOUR ON CARDIOVASCULAR BIOMARKERS IN ACTIVE, HEALTHY ADULTS.

HOLDER, S., LOW, D., GRAVES, L., CARTER, S., BRISLANE, A., HOPKINS, N.

LIVERPOOL JOHN MOORE'S UNIVERSITY

Introduction
Sedentary behaviour (SB) is an independent predictor of cardiovascular disease morbidity and mortality, however little is known about the effect of SB on markers of cardiovascular health in active adults. Therefore, the aim of this study was to determine whether differences in SB are associated with cardiovascular risk in a healthy population who achieve World Health Organisation physical activity (PA) recommendations. We hypothesised that higher SB would be associated with greater cardiovascular risk.

Methods
Twenty-seven healthy participants (aged 27.6±8 years, 17 males) were recruited. Body composition was assessed via bioelectrical impedance, and waist and hip circumference. Following 15 minutes of supine rest, ultrasound assessments of brachial and femoral artery flow-mediated dilation (FMD) and left common carotid artery intima-media thickness (cIMT) were conducted. Central (carotid-femoral) pulse wave velocity (PWV) and resting middle cerebral artery blood flow velocity (MCAv) were assessed via applanation tonometry and transcranial Doppler ultrasonography respectively. Cardiorespiratory fitness (CRF; VO2peak) was assessed on a treadmill using the modified Bruce protocol. PA and SB were objectively measured for seven days via accelerometry and inclinometry respectively. Participants were grouped into tertiles according to average daily sedentary time during waking hours (inclinometer data): LoSIT (n=9), MidSIT (n=9) and HiSIT (n=9) and a mixed linear model determined the effect of group on cardiovascular biomarkers. Data are presented as mean±standard deviation.
Results
Groups did not differ for moderate-vigorous PA (MVPA) (LoSIT 64±21mins/day, MidSIT 74±22mins/day, HiSIT 68±28mins/day; P=0.537), but were significantly different for SB (LoSIT 6.8±1hours/day, MidSIT 8.4±0.2hours/day, HiSIT 9.3±0.5hours/day; P<0.001). There was a significant difference between groups in VO2peak (LoSIT 50.6±3.7ml/min/kg, MidSIT 49.3±10.3ml/min/kg, HiSIT 40.4±7.4ml/min/kg; P=0.015). No differences were observed between groups for body composition, MCAv, cIMT, FMD and PWV (P>0.05).
Discussion
We demonstrate for the first time that in an active population, SB appears to be detrimentally associated with CRF, but no other cardiovascular health biomarkers. Achieving the guidelines of 150 minutes of MVPA per week therefore appears to be protective of body composition, cerebral blood flow, arterial stiffness and vasodilator function in highly sedentary adults. However, given that diminished CRF is a strong predictor of cardiovascular mortality, our data suggests that reduction of sedentary time remains a critical recommendation for cardiovascular risk reduction, even in physically active individuals.

NON-INVASIVE EVALUATION OF CARDIOVASCULAR AND METABOLIC RESPONSES TO ARM AND LEG EXERCISE IN ELITE KAYAKERS

ZUCCARELLI, L., RASICA, L., MARZORATI, M., PORCELLI, S.
NATIONAL RESEARCH COUNCIL

Introduction
Arm exercise is known to elicit different cardiovascular and metabolic responses from leg exercise (Sawka 1986). A slower V'O2 kinetic response, a greater V'O2 slow component amplitude, and a higher oxygen cost have been observed (Koppo et al. 2002), according to higher proportion of type II muscle fibers, worse matching between O2 delivery and O2 uptake and lower muscle oxidative capacity (Franklin 1985, Calbet et al. 2005). Aim of this study was to evaluate cardiovascular and metabolic responses to arm cranking compared to leg pedaling in highly trained athletes.
Methods
Eight elite kayakers were recruited. During incremental exercise up to exhaustion and several repetitions of submaximal constant work-rate exercises (20, 40, 60, and 80% of V'O2peak), both with arm (AC) and leg (LC), were determined: breath-by-breath pulmonary O2 uptake (V'O2); stroke volume (SV) and cardiac output (CO) by transthoracic bioimpedence; vastus lateralis and triceps muscle fractional O2 extraction by near-infrared spectroscopy (Δ[deoxy(Hb±Mb)]).
Results
During incremental exercise, Wpeak was significantly lower (160 vs. 280 w) in AC compared to LC and AC V'O2peak achieved ~90% of LC value (3.132±0.541 vs. 3.513±0.467 l.min-1). No differences were observed in SVpeak and COpeak between AC and LC. Δ[deoxy(Hb+Mb)]peak was 79±19% in AC and 68±18% in LC. During constant work-rate exercises, oxygen cost of exercise was higher in AC compared to LC. SV appeared to level off at 60% in both conditions. Time constant of V'O2 kinetics was similar between AC and LC. No differences were observed in the amplitude of V'O2 slow component at the highest intensities.
Discussion
In conclusion, physiological adaptations induced by chronic exercise training seem to mitigate the different cardiovascular and metabolic responses to maximal and submaximal exercise of arm cranking, compared to leg cycling.
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Oral presentations

OP-BN02 Muscle-tendon function

MUSCLE-TENDON LENGTH AND FORCE AFFECT HUMAN TIBIALIS ANTERIOR CENTRAL APONEUROSIS STIFFNESS IN VIVO

RAITERI, B., CRESSWELL, A.G., LICHTWARK, G.A.
THE UNIVERSITY OF QUEENSLAND

Introduction
In pennate muscle, the elastic sheet-like aponeurosis is important for transmitting force from its muscle fibres to the free tendon. However, unlike the free tendon, the aponeurosis undergoes a complex three-dimensional loading regime during contraction, which can alter its stiffness in passive versus active muscle (Azizi et al., 2009). If additional factors can also drive changes in aponeurosis stiffness during a contraction (which remains to be tested), then this would have implications for how we model muscle and tendon interactions; and may also serve to optimise muscle efficiency during everyday tasks such as walking. Therefore, the aim of this study was to determine if

factors other than muscle activation could modulate the apparent in vivo longitudinal stiffness of the human tibialis anterior (TA) central aponeurosis.
Methods
We employed two ultrasound techniques to examine in vivo fascicle behaviour and central aponeurosis stiffness of the human TA during force-matched, voluntary isometric dorsiflexion contractions at three muscle-tendon unit (MTU) lengths (n=11). Using elastography and the measured muscle shear modulus, we determined an index of muscle force (Hug et al., 2015), which could be used to validate if our TA muscle force estimates across MTU lengths were similar.
Results
Mean TA muscle shear modulus values were very similar for the three MTU lengths at the low (mean range; 55 kPa) and moderate (mean range: 97-99 kPa) muscle forces. TA MTU length increased both the length and apparent longitudinal stiffness of its central aponeurosis at the low (short: 30.8±16.2 N/mm; medium: 47.2±26.5 N/mm; long: 69.0±28.8 N/mm) and moderate (short: 44.1±15.5 N/mm; medium: 66.3±28.0 N/mm; long: 104.7±41.8 N/mm) muscle forces ($P<0.01$). The above were associated with reduced magnitudes of TA fascicle shortening at both forces as MTU length increased ($P<0.01$).
Discussion
This study provides the first in vivo evidence that MTU length and muscle force are able to modulate the apparent in vivo longitudinal stiffness of the human TA. We found that the central aponeurosis was stretched less from a longer starting length for the low and moderate force-matched conditions. The rightward shift and increase in slope of the aponeurosis force-length curves with increasing MTU length was likely due to a combination of parallel lengthening of the aponeurosis under passive conditions and altered transverse aponeurosis strains. Further research on muscles that produce power during walking and running is warranted to examine the influence of variable aponeurosis stiffness on muscle efficiency.
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Contact
brent.raiteri@rub.de

MUSCLE-TENDON INTERACTION DURING AN ENERGY DISSIPATION TASK

WERKHAUSEN, A.1, ALBRACHT, K.2,3, CRONIN, N.J.4, MEIER, R.5, BOJSEN-MOELLER, J.1, SEYNNES, O.R.1

1: NSSS (OSLO, NORWAY), 2: GSU (COLOGNE, GERMANY), 3: UAS (AACHEN, GERMANY) 4: JYU (JYVASKYLA, FINLAND), 5: ETH (ZURICH, SWITZERLAND)

Introduction
In daily activities requiring deceleration, active lengthening of muscle fascicles allows energy dissipation. Animal studies have shown the essential role of series elastic elements (SEE) to safely enable power attenuation during energy dissipation (1). In humans, energy dissipation has thus far been studied during locomotion (2), where the behaviour of the muscle-tendon unit (MTU) is also driven by a propulsion phase. This study aimed to examine the behaviour of the triceps surae MTU during a pure energy dissipation task.
Methods
Thirty-nine males were recruited to perform a single-leg stepping-down task with- and without added weights (+20% of body weight). Ultrasound measurements of gastrocnemius (GM) and soleus (SOL) fascicle length and displacement of the GM myotendinous junction were combined with 3D kinematics and kinetics to determine instantaneous lengths of MTUs, fascicles, Achilles tendon and the SEE.
Results
During the landing phase (negative ankle power production), GM and SOL MTUs lengthened (GM 31 mm; SOL 36 mm). Fascicles shortened slightly initially, when ankle moment production was low, and lengthened thereafter (by 19 mm and 11 mm for GM and SOL, respectively). Achilles tendon and SEE lengthened (7 and 19 mm, respectively) until peak moment. During force decay, tendon length remained similar, whilst a recoil of the SEE was observed (6 mm). Adding weight caused an increase in ankle work (18 %) and resulted in a greater MTU lengthening. However, this lengthening was taken up by a greater stretch of tendon and SEE while fascicle behavior did not change ($p<0.05$).
Discussion
The rapid stretch of the MTU was taken up by the tendon and SEE, allowing a delayed energy absorption through fascicle lengthening with lower velocities compared to the MTU. The additional work caused by added weight was taken up by a greater stretch of elastic tissues, which supports the notion of a protective mechanism against high fascicle strains. Additionally, the elastic energy stored during SEE stretch and released during recoil drives fascicle lengthening, albeit this was not observed for the Achilles tendon. Similar to animals, the stretch of the human triceps surae MTU is buffered by elastic structures to prevent muscle damage. These results are comparable to observations made during stair descent, with timing differences attributed to the propulsive movement occurring during stair negotiation.
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Contact
amelie.werkhausen@nih.no

MONITORING MUSCLE-TENDON ADAPTATION IN ELITE ATHLETES: PRELIMINARY DATA FROM A 1-YEAR LONGITUDINAL INVESTIGATION

KÖNIG, M.1,2, EPRO, G.1,2, MCCRUM, C.2,3, BÄDORF, M.2, SCHADE, F.4, KARAMANIDIS, K.1

GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Muscles and tendons adapt to mechanical loading (Arampatzis et al., 2007). However, different time courses of adaptation in response to training (Mersmann et al., 2016) may lead to discordance within the muscle-tendon unit (MTU), potentially increasing the risk of injury. In this study, we monitored the triceps surae (TS) MTU mechanical properties in elite jumpers over one year of training and competing, in order to detect potential training-induced discordance between muscle and tendon adaptation.
Methods

This preliminary analysis is part of an ongoing nationwide study on the TS MTU adaptation of more than 30 jumpers (long jump, triple jump, high jump and pole vault) of the German national team. Maximum ankle plantarflexion moment and Achilles tendon (AT) stiffness of nine jumpers (23±3y) and one jumper 10 months post Achilles tendon reconstruction, were regularly assessed over 1 year at their respective Olympic training centres, using a mobile device (dynamometry and ultrasonography; TEMULAB®, Protendon, Aachen, Germany). Both time course and coefficients of variation (CV) of muscle and tendon adaptation were evaluated.
Results
On average, 16 measurements were conducted for these first 10 athletes. Both TS muscle strength and AT stiffness were higher in the take-off leg (average: 371±58Nm and 874±113N/mm, respectively) compared to swing leg (348±44Nm/kg; 812±110N/mm). In both legs, the relative changes of TS muscle strength and AT stiffness over one year showed similar patterns, meaning that changes in TS muscle strength were followed by changes in AT stiffness, with CVs of 8.9±2% and 12.9±4.9% respectively. However, following AT reconstruction, TS muscle strength but not AT stiffness was consistently lower in the affected leg (average over all data points: 1.8±0.2Nm/kg; 503.7±90.7N/mm) compared to the healthy leg (3.4±0.2Nm/kg; 496.8±33.1N/mm), despite intensive training.
Discussion
Our results indicate limb-specific differences of both TS muscle strength and AT stiffness due to training, with higher values for the take-off leg compared to the swing leg. Over one year there was a concordant adaptation of TS muscle strength and AT stiffness in both legs, suggesting a low tendon injury risk due to discordance within TS MTU. Following AT reconstruction, a consistent deficit in TS muscle strength but not AT stiffness was seen compared to the healthy leg, meaning that AT rupture and reconstruction could be risk factors for irreversible discordance within TS MTU.
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Contact
m.koenig@dshs-koeln.de
1: London South Bank University, 2: German Sport University Cologne, 3: Maastricht University, 4: Olympic Training Centre Rheinland

ACHILLES TENDON MECHANOSENSITIVITY IS PRESERVED IN OLD AGE: IN VIVO EVIDENCE FROM A 1.5 YEARS LONG RESISTANCE TRAINING INTERVENTION

EPRO, G.1,2, MIERAU, A.1, DOERNER, J.3, LUETKENS, J.3, SCHEEF, L.3, KUKUK, G.3, BOECKER, H.3, MAGANARIS, C.4, BRÜGGEMANN, G.P.2,5, KARAMANIDIS, K.1

GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Ageing deteriorates musculoskeletal system structure and function and limits its adaptability to mechanical loading. Medium-term (12-14 weeks) exercise interventions in older adults have been shown to increase tendon stiffness by increasing the tendon's Young's modulus [1], rather than the tendon's cross-sectional area (CSA). However, little is known about the time-adaptive response relationship of the tendon in long-term (years) interventions involving alteration in mechanical loading. Therefore, we investigated whether the older human Achilles tendon (AT) demonstrates mechanosensitivity and alterations in material and/or size in response to long-term mechanical loading.
Methods
Thirty-four older female adults (age: 65±7 y) were recruited to a medium-term (14 weeks; n=21) strength training intervention with high AT strain cyclic loading (five sets of four repetitions of isometric plantarflexion contractions 3 times a week with 90% of MVC as in [2]) or a control group (n=13), with a sub-group of the intervention group (n=12) continuing exercise for 1.5 years. AT stiffness and Young's modulus were quantified in vivo using ultrasonography and dynamometry. Tendon CSA was measured along the whole free AT by means of magnetic resonance imaging.
Results
Following 14 weeks of resistance training, the intervention group showed a significant ($p<.05$) increase in ankle plantarflexor muscle strength (141.5±36.2 vs 116.3±30.8 Nm at baseline), along with a 23% increase in AT stiffness (598.2±141.2 Nmm-1 vs 488.4±136.9 Nmm-1 at baseline), 20% increase in Young's modulus (1.63±0.46 GPa vs 1.37±0.39 GPa at baseline) and a homogenous hypertrophy by about 6% along the entire free AT. However, continuing the exercise training for 1.5 years did not cause any further changes in muscle strength and tendon properties. The control group did not show any differences in muscle and tendon functional and structural properties between time points.
Discussion
The AT seems to have the capability to increase its stiffness in response to 14 weeks of mechanical loading exercise by altering both its material and size, and may thereby tolerate higher mechanical loading by reducing both the strain and stress it experiences during tensile loading. Continuing strength training appears to maintain, but not cause any further adaptive changes in tendons, which implies that the time-adaptive response relationship to mechanical loading is non-linear in ageing tendons.
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1: London South Bank University, 2: German Sport University Cologne, 3: University of Bonn, 4: Liverpool John Moores University, 5: University of Cologne

EIGHT WEEKS OF PROGRESSIVE RESISTANCE TRAINING DO NOT CHANGE PLANTARFLEXOR MUSCLE-TENDON PROPERTIES IN CHILDREN WITH SPASTIC CEREBRAL PALSY

KRUSE, A., SCHRANZ, C., SVEHLIK, M., TILP, M.

UNIVERSITY OF GRAZ

Introduction
Mechano-morphological properties of the plantarflexor muscle-tendon unit (MTU) are altered in children with spastic cerebral palsy (CP) (Theis et al., 2016) and related to muscle weakness. Studies reported that progressive resistance training (PRT) can improve lower limb muscle strength in these patients (Scholtes et al., 2012), however, the effects on muscle and tendon properties have not received much

attention yet. Therefore, the purpose of this study was to investigate the effects of PRT on the mechano-morphological properties of the plantarflexor MTU in children with spastic CP.
Methods
Ten children with spastic CP (Gross motor function classification system level I and II) participated in a home-based, eight-week PRT for three times a week. Training comprised five functional lower limb exercises (e.g. sit-to-stand, heel raises, lateral step-ups). Load was increased progressively. Morphological and mechanical properties of the gastrocnemius medialis and the Achilles tendon (e.g. muscle fascicle length, thickness, muscle and tendon stiffness) were assessed four times (-8wk, 0wk, 8wk, 24wk) during both passive dorsiflexion rotations and maximum voluntary contractions using ultrasound and dynamometry. Additionally, functional performance was assessed by six-minute walk test (6MWT) and timed up and down stairs (TUDS). Statistical analysis was conducted by non-parametric Friedman test and post hoc analysis.
Results
Contrary to our expectations, there was neither a significant change in muscle and tendon morphological nor mechanical properties ($p>0.05$) after eight weeks of training. Even when normalized to body mass, we could not find an increase in maximum producible torque. Similarly, passive resistive torque did not change. While performance during 6MWT was unaltered, we found significant improvements in TUDS (12.8s (0wk)-10.8s (8wk)) following the training period.
Discussion
Eight weeks of PRT did not change gastrocnemius muscle and Achilles tendon properties as well as muscle strength in children with spastic CP. Since other studies reported changes in strength after twelve weeks of PRT (Scholtes et al., 2012), we assume that the intervention period may have been too short to evoke detectable changes on muscular level. Furthermore, variability of the subjects' conditions and motivational aspects might have influenced the results. Despite the lack of changes in musculotendinous structure, improvements in strength-related but not endurance-related functional tests were observed.
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Contact
annika.kruse@edu.uni-graz.at
1: KFU (Graz, Austria), 2: MU (Graz, Austria)

THE EFFECT OF COLD WATER IMMERSION ON MEDIAL GASTROCNEMIUS MUSCLE ARCHITECTURE AND PERFORMANCE POST-EXHAUSTIVE STRETCH-SHORTENING CYCLE EXERCISE

KOSITSKY, A., CRONIN, N., AVELA, J.
UNIVERSITY OF JYVÄSKYLÄ

Introduction
Elite athletes are expected to perform at their highest level repeatedly within short time periods. This quick turnaround may not always allow for adequate recovery of the neuromuscular system, diminishing subsequent performance (Reilly and Ekblom, 2005). Cold water immersion (CWI) is a widely popular method implemented to aid in the recovery from fatiguing exercise, yet the literature is inconclusive on its efficacy. Further, although the architectural properties of a muscle impact its function (Burkholder et al, 1994) and have been shown to change after stretch-shortening cycle (SSC) exercise (Ishikawa et al, 2006), there is no available data on the influence of CWI on muscle architecture. The main purpose of this study was to investigate the effect of CWI in the recovery of muscle architecture and performance.
Methods
Male footballers (n=12) from a Finnish premier division's U20 team participated. Exhaustive SSC exercise was performed on a sledge apparatus inclined 24.9° from horizontal. Subjects performed 5 sets of 20 maximal drop jumps (DJ) followed by continuous submaximal rebounding until either 50% of maximal height could not be attained or volitional fatigue. Subjects were randomly assigned to either passive recovery or CWI, consisting of 20 minutes with the lower legs in an empty bucket or immersed in water at 10°C, respectively. Pennation angle (PA), fascicle length (FL), and muscle thickness via ultrasound (US), maximal torque (MVC), DJ performance with kinetics and kinematics, muscle soreness (DOMS), and creatine kinase (CK) were measured pre- and immediately post-exercise and at 24h and 48h follow-up sessions. Lactate was measured only pre- and post-exercise.
Results
Initial results suggest a reduction in jump height (post -14.7%, 24h -5.9%) that is similar between groups. MVC decreased only post (-10.2%) with no group effect. DOMS increased at rest (post, 24h), during MVC (post), and DJ (post, 24h, 48h) for both groups. CK increased at 24h and 48h and lactate was higher post, both with no group differences. Preliminary US data at rest (n=4) suggests CWI may have a minor effect immediately post-intervention, demonstrating slightly increased PA and decreased FL. Additional data during MVC and DJ will be analyzed.
Discussion
Current data is comparable to that previously found after a similar fatiguing model (Ishikawa et al, 2006). Early results suggest that CWI is no better than passive recovery in restoring muscle architecture or performance after exhaustive SSC exercise. Final analysis may elucidate this further.
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Contact
akositsky@hotmail.com

Oral presentations

OP-PM60 Stroke and Parkinson diseases

EFFECTS OF A SINGLE SESSION OF BIHEMISPHERIC TRANSCRANIAL DIRECT CURRENT STIMULATION ON THE STRENGTH AND ACTIVATION LEVEL OF KNEE EXTENSORS IN PATIENTS WITH STROKE.

GEIGER, M.1, ROCHE, N.1, ZORY, R.2

1:AP-HP, RAYMOND POINCARÉ TEACHING HOSPITAL, GARCHES, FRANCE. 2: UNIVERSITY OF NICE SOPHIA ANTIPOLIS, FRANCE.

Introduction
After a stroke, patients may suffer from paresia and lack of motor selectivity. Recently, transcranial Direct Current Stimulation (tDCS) has become a neuromodulation technique enable to improve motor function of stroke patients. Tanaka et al. showed that uni-hemispheric tDCS (UNI-tDCS) in anodal condition increase paretic quadriceps maximal strength (Tanaka et al, 2011). Recently, Lindenberg et al (2010) studied the effects of bihemispheric tDCS (BI-tDCS) and demonstrated that BI-tDCS induced more improvement of motor function in stroke patient than UNI-tDCS (Lindenberg et al, 2010). Therefore, the aim of this study was to evaluate the effects of BI-tDCS on maximal strength and activation level of paretic knee extensors muscles in patients with stroke.
Methods
Thirteen patients with chronic stroke (10 men, age: 53±21.6 years, anteriority of stroke: 9.5±6.7 years) were included in a single-blind sham-controlled study. Subjects participated in two randomized visits: stimulation and sham. During the stimulation visit the anode was placed above the motor area (M1) of the injured hemisphere and the cathode above M1 of the unlesioned hemisphere. The stimulation intensity was set at 2mA for 20 minutes. Maximum voluntary contraction (MVC), electrically evoked contraction during rest (twitch) and during MVC (twitch interpolation) were carried out before, during and after stimulation period in the 2 experimental conditions.
Results
Data were expressed in percent from pre-intervention of each visit. Friedman's anova showed no change in the MVC (p=0.37), maximal RMS during MVC (p=0.43), maximal peak twitch (p=0.13) and voluntary activation level (p=0.95) of the knee extensor muscles.
Discussion
The BI-tDCS has no beneficial effects on the MVC or activation level. These results are in contradiction with previous results of Tanaka et al (2011) obtained with UNI-tDCS. However, Batsikadze et al (2013) showed that a cathodal stimulation at 2mA for 20min induce an increased in cortical excitability instead of inhibited it (Batsikadze et al, 2013). Thus, in our experimental paradigm, it can be expected that cathodal applied on M1 area of unlesioned hemisphere had the same effects and may have modify the interhemispheric inhibition balance, but with no indications of the change's direction. These effects might play a role in the absence of significant improvement in the present study.
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Contact
maxime.geiger@gmail.com

CO-CONTRACTION OF LOWER LIMB MUSCLES DURING GAIT IN POST-STROKE PATIENTS

SOUISSI, H.1, ZORY, R.1, BREDIN, J.2, ROCHE, N.3, GERUS, P.1

UNIVERSITÉ NICE SOPHIA ANTIPOLIS

Introduction
Impairments resulting from hemiparetic stroke lead to persistent difficulties with walking (Richards et al., 1999). Abnormal co-contraction patterns of lower limb muscles might be a compensatory mechanism to deal with gait impairments. Co-contraction has generally been explored by electromyography (EMG) measurement (Kellis, 1998). However, the relationship between EMG activity and force is not linear particularly during dynamic activities such as gait (Buchanan et al., 2004). The aim of this study was to assess muscle co-contraction obtained from muscle moments in chronic hemiparetic patients presenting a stiff-knee gait (SKG) during walking.
Methods
Twelve hemiparetic patients presenting a SKG walked at their natural gait speed while 12 healthy adults walked at their natural and slow gait speed. Spatiotemporal, kinetic and kinematic gait parameters were determined for both lower limbs. Co-contraction index at the knee and the ankle was calculated according to the method described by Falconer and Winter (1985) from muscle moments estimated using an EMG-driven model during the first (DS1) and second (DS2) double support and the single support (SS) phases and the swing phase (SW).
Results
The results show that chronic stroke patients demonstrated reduced ankle co-contraction and increased knee co-contraction during DS1 phase, increased ankle co-contraction during DS2 phase and increased knee co-contraction during SW phase on the paretic side. On the non-paretic side, muscle co-contraction was higher at the knee during SS phase.
Discussion
Chronic stroke patients walking with a SKG exhibited increased co-contraction around the knee on the paretic side in the loading period of gait (DS1 phase) most likely to increase knee stability (Fonesca et al., 2006). Increased co-contraction around the ankle on the paretic side combined with triceps surae muscle weakness could explain the lack of propulsion. Increased knee co-contraction during the SW phase could be caused by the spasticity-related muscle overactivity of the rectus femoris in pre-swing phase (Sung et al., 2000). While the reduced ankle co-contraction on the paretic side may contribute to poor postural stability, the presence of increased knee co-contraction on the non-paretic side during stance may be an adaptation to help maintain postural stability during gait. Nevertheless, excessive co-contraction could increase the metabolic cost and thus the fatigability (Missenard et al., 2008).
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CORRELATION BETWEEN STRENGTH AND FUNCTIONAL TESTS IN ELDERLY PEOPLE WITH PARKINSON'S DISEASE

CLAEL, S., NAGAZAWA, J., PAIVA, T., BRANDÃO, E., RODRIGUES, J., CALAND, L., WELLS, C., JACÓ, R., BEZERRA, L.
UNIVERSIDADE DE BRASÍLIA

Introduction
The Parkinson's Disease is responsible for the decrease of activities of daily living (ADL) and mobility limitations. Correlating functional tests with force can help improve training methodologies for these individuals, since the human body works as a system. Therefore, the aim of this study was to analyse if there are correlations between strength and functional tests.
Methods
Data are from 35 individuals (< 60 years), recruited in the program Viva Ativo. Body composition (assessed by dual energy x-ray absorptiometry) and knee extension strength were assessed. Physical function was measured using the Sit and stand up test (SL), timed up and go test (TUG) and walk test 6 minutes (6 Min). Shapiro-Wilk test, Pearson and Spearman correlations were used for statistical analysis.
Results
The higher correlations were, SL and PT/BW E 3ª r = 0,449; TUG and PT/BW D 2ª r = -0,363; 6 Min and PT/BW D 2ª r = 0,617. All results were significant, $p < 0,05$.
Discussion
Determining values of strength and functional tests can help identify individuals with a higher risk of impairment, and can collaborate on prescribing physical exercises focused to the capabilities that each individual is losing. The results indicate that the correlation between the functional tests 6 Min, SL and TUG with the force can generate dependent variables. Barbat-Artigas et al. (2012) found a correlation between a different protocol of the SL test and the 6-min walk with the isokinetic test. Horstman et al. (2008) found a moderate correlation between TUG and maximal voluntary contraction of knee extensors, and a strong correlation between TUG and maximal voluntary contraction of the knee flexors
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Contact
sachaclael@hotmail.com

ARE ANTICIPATORY POSTURAL ADJUSTMENTS PRIOR TO GAIT INITIATION COMPROMISED IN PEOPLE WITH PARKINSON'S DISEASE WITH FREEZING OF GAIT?

SCHLENSTEDT, C., HORAK, F., NUTT, J., MANCINI, M.
CHRISTIAN-ALBRECHTS-UNIVERSITY KIEL, GERMANY; OREGON HEALTH & SCIENCE UNIVERSITY PORTLAND, USA

Introduction
Patients with Parkinson's disease (PD) and freezing of gait (FOG) have impaired postural control in comparison to patients without FOG. It is unclear whether impaired lateral weight shifting prior to step initiation contributes to the occurrence of start hesitation. Alternatively, the preparation phase of gait initiation might be normal and start hesitation due to inability to start stepping following an unimpaired anticipatory postural adjustment. The aim of this study was to characterize forces and muscle activation patterns associated with anticipatory postural adjustments during self-initiated gait in subjects with PD with a history of FOG (PD+FOG) compared to those without FOG (PD-FOG) and healthy controls (HC).
Methods
Thirty-three PD+FOG (MDS-UPDRS-III: 44.2 (13.2); age: 69.2 (6.5)), 30 PD-FOG (MDS-UPDRS-III: 41.1 (10.1); age: 69.6 (8.5)) and 32 HC (age: 69.4 (6.8)) were included. Stance (30sec) followed by gait initiation was analyzed without and with a cognitive dual task (DT, consisting in counting backwards by three). Anticipatory postural adjustments were characterized with inertial sensors (waist and shins) and muscle activity of the tensor fasciae latae (TFL), gastrocnemius (GAS) and tibialis anterior (TIB) muscles was captured with EMG recordings. Severity of FOG was quantified with the FOG ratio of horizontal shins accelerations during a 360 degree turning for 1 minute. Eight trials (of 190) were associated with FOG.
Results
PD+FOG and PD-FOG did not differ in disease duration, MDS-UPDRS-III, Hoehn & Yahr scale and the three groups did not differ in age or gender ($p<0.05$). PD+FOG and PD-FOG did not differ in size of their APAs when testing without DT. In the DT condition, PD+FOG had significantly smaller medio-lateral (ML) and anterio-posterior (AP) size of APA compared to PD-FOG and HC ($p<0.01$). Within the PD+FOG, the ML size of APA (DT) was positively correlated with the severity of FOG (NFOG-Q) (rho=0.477, p=0.025). The groups did not differ in the amount of co-contraction of bilateral TFL over 2 seconds prior to first step toe-off.
Discussion
Lateral weight shift prior to step initiation was smaller in PD+FOG than PD-FOG or HC but only in the DT condition. Surprisingly, the worst the FOG, the larger the ML weight shift in the postural preparation phase. Co-contraction immediately prior to step execution cannot explain differences in postural preparation for a step between PD+FOG and PD-FOG.
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Contact
c.schlenstedt@neurologie.uni-kiel.de

PERTURBATION DURING TREADMILL TRAINING IMPROVES DYNAMIC BALANCE AND GAIT IN PARKINSON'S DISEASE: A SINGLE-BLIND RANDOMIZED CONTROLLED PILOT TRIAL

STEIB, S.1, KLAMROTH, S.1, GAßNER, H.2, PASLUOSTA, C.3, ESKOFIER, B.3, WINKLER, J.2, KLUCKEN, J.2, PFEIFER, K.1
FAU (ERLANGEN-NÜRNBERG, GERMANY)

Introduction
Gait and balance dysfunction are major symptoms in Parkinson's disease (PD). Treadmill training improves gait characteristics in this population (Mehrholz et al., 2015), but does not reflect the dynamic nature of controlling balance during ambulation in everyday life contexts. The aim of this study was to evaluate whether postural perturbations during treadmill walking lead to superior effects on gait and balance performance compared to standard treadmill training.
Methods
In this single-blind randomized controlled trial, forty-three PD patients (H&Y 1 – 3.5) were allocated to either an eight week, twice-weekly perturbed treadmill intervention (n=21) or a control group (n=22) training on the identical treadmill without perturbations. The prototypic treadmill used in this study constantly applied three-dimensional tilting movements to the walking surface (Klamroth et al., 2016). Patients were assessed at baseline, post-intervention, and at three months follow-up. Primary endpoints were overground gait speed (10m walk test) and balance (Mini-BESTest). Secondary outcomes included fast gait speed, walking capacity (2min walk test), dynamic balance (Timed Up-and-Go), static balance (postural sway), and balance confidence (ABC scale). A two-way mixed ANOVA was implemented to test for within-group changes and between-group differences over time. Ordinal data and variables with skewed data distributions were analyzed using non-parametric methods (Wilcoxon signed-rank test and Mann-Whitney U-test). Effect sizes were computed using Cohen's d.
Results
At post-intervention, both groups showed similar improvements in overground gait speed (p=.009, perturbation: d=0.28; control: d=0.23). Only the perturbation group additionally increased their walking capacity (p=.038; d=0.23), and demonstrated a tendency for improved fast gait speed. Only the perturbation group improved balance, with reduced Timed Up-and-Go times (p=.048; d=-0.33) and a trend for improvement in the MiniBESTest reactive postural control subscale. Intervention effects were not sustained at follow-up.
Discussion
Treadmill training with postural perturbations is feasible in early- to mid-stage PD patients and demonstrates superior effects on gait and dynamic balance performance compared to standard treadmill rehabilitation. Long-term effects need to be investigated in future trials.
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Oral presentations

OP-PM05 Paralympics

RELATIONSHIP BETWEEN PHYSIOLOGY AND PERFORMANCE OF HANDCYCLING IN ABLE-BODIED SUBJECTS

QUITTMANN, O.J., ABEL, T., STRÜDER, H.K.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Incremental step tests and sprint tests with lactate measurements are commonly used in handcycling diagnostics. However, it is still unclear if the physiological parameters elucidate the athlete's performance characteristics. Therefore, the aim of this study was to analyze the relationship between physiological and performance measures under laboratory conditions in handcycling.
Methods
Twelve able-bodied triathletes without handcycling experience performed an initial familiarization protocol. The tests were performed in a racing handcycle that was attached to an ergometer. Following the familiarization, a 15s-All-Out sprint test was performed in which the peak power output (POmax,AO15) and the glycolytic rate (VLamax) were determined. Additionally, the participants performed an incremental step test. At the end of every stage, lactate concentration, heart rate and perceived exertion were collected. Out of the step test, the maximal achieved power output (POmax,ST) and the interpolated lactate threshold (PO4mmol) were calculated. Power values were correlated among each other and with the alactic time (talac), the maximal lactate concentration after the sprint test (Lamax,AO15), the maximal heart rate during the step test (HRmax,ST), the VLamax, and the maximal lactate concentration during the step test (Lamax,ST).
Results
POmax,AO15 was significantly correlated with VLamax (r = 0.604, p = 0.037). POmax,ST was significantly correlated with PO4mmol (r = 0.577, p = 0.060), Lamax,AO15 (r = -0.680, p = 0.015) and VLamax (r = -0.649, p = 0.022). PO4mmol was significantly correlated with Lamax,ST (r = -0.605, p = 0.037).
Discussion
The significant correlations indicate that anaerobic and aerobic performance measures in handcycling are related to their physiological equivalents. The usage of physiological measures in diagnostics seems to be promising for developing performance and the examination of different training regimes. Future research should replicate this study with elite athletes.
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Contact
O.Quittmann@dshs-koeln.de

EVALUATION OF DIFFERENT BLOOD LACTATE THRESHOLD CONCEPTS FOR CONSTANT LOAD PERFORMANCE PREDICTION IN HANDCYCLING

STANGIER, C.1, ABEL, T.1,3, ZELLER, S.1, QUITTMANN, O.J.1, PERRET, C.2,3, STRÜDER, H.K.1
GERMAN SPORTS UNIVERSITY

Introduction
Endurance capacity is one of the main performance determinants in handcycling, a steadily growing Paralympic discipline.1 The maximal lactate steady state (MLSS) provides crucial information about both training and fitness level of an athlete.2 Different exercise tests are currently in use to determine lactate thresholds (LT) to predict MLSS. This study aims to evaluate the precision of the two primarily applied concepts in handcycling.
Methods
In a repeated measures cross over design, 11 male highly trained spinal cord injured (Th12 to L1) handcyclists (age; 40±9 yrs, height; 183±8 cm, body mass; 74±8 kg) performed a graded exercise test (GXT) and a lactate minimum test (LMT) to determine a LT (LT4mmol·L-1 and LTLMT, respectively). Constant load tests (CLT; 30 min) at a workload corresponding to the LT were completed on a separate day to validate the criteria for MLSS (change of ≤1mmol·L-1 during the last 20 min). Oxygen uptake (VO2), heart rate (HR) and blood lactate (La) were measured during the exhaustive tests to determine peak values and recorded every 5 min during the CLT.
Results
A paired t-test revealed no significant difference between the workloads at the determined thresholds (LT4mmol·L-1: 144±31 W vs. LTLMT: 134±15 W; p=0.119). While two-way ANOVAs with repeated measures showed no significant differences for VO2 (p≥0.07), fractional VO2 (p≥0.12) and LA (p≥0.07), HR was significantly higher (p≤0.04) during CLT at LT4mmol·L-1 compared to CLT at LTLMT. Determinations of LT4mmol·L-1 and LTLMT did not meet the criteria for MLSS within the CLT for 4 and 2 athletes, respectively.
Discussion
As endurance training induced structural and metabolic adaptations have an effect on blood-lactate kinetics during exercise, the accuracy of LTLMT could be impaired.3 Similar but inverse results are verified for the fixed 4 mmol·L-1 lactate threshold overestimating the MLSS in highly trained endurance athletes.2 While both exercise tests revealed valid estimates to predict a constant load performance for handcyclists, responses of elite athletes should be analysed individually and verified by means of several CLT. Considering this limitation, the current data enable coaches in handcycling to choose an adequate exercise test to assess performance data and derive exercise regimen.
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Contact
c.stangier@dshs-koeln.de
1 Institute of Movement and Neurosciences, German Sport University Cologne, Germany.
2 Institute of Sports Medicine, Swiss Paraplegic Centre, Nottwil, Switzerland
3 European Research Group in Disability Sport (ERGiDS)

WHAT DOES "INCLUSIVITY" MEAN WHILE PLAYING SITTING VOLLEYBALL? : FOCUSING ON THE COMPETITION BETWEEN DISABLED AND NON-DISABLED PLAYERS

TANAKA, A.
MUSASHI UNIVERSITY

Introduction
This study aimed to investigate what "inclusivity" means while playing sitting volleyball. I especially focus on the competition between disable-bodied and non-disabled players in Japanese sitting volleyball teams. Persons with disability have played sitting volleyball since 1956 in Netherlands. Since people can play volleyball while sitting on the floor, this game may seem like an inclusive version of the sport. In Japan, persons with and without disability enjoy and compete in sitting volleyball. However, we should pay attention to and consider the "fairness" in this game; it seems difficult to make disabled and non-disabled players compete "fairly." How do people achieve "inclusivity" in playing? Therefore, a deeper discussion on including every individual while playing sitting volleyball is required.
Methods
To identify this, I first considered the meaning of competition for disable-bodied players. Second, the meaning of playing sitting volleyball for able-bodied players was examined through interviews. The subjects were 3 able-bodied sitting volleyball players in Japan, including players who have and have not received training in standing volleyball. The interview focused on the following: a) the motivation to start playing the game, b) the impression or feelings when they started playing, c) the reason they continued to play, d) their stance on playing currently, e) their goals for playing, and f) what playing sitting volleyball meant to them.
Discussion
The meaning of competition was clarified and discussed in the context of what inclusivity means while playing sport and how it can be achieved.
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HEAD IMPACT OF SLALOM GATES ON PARALYMPIC ALPINE SIT-SKIERS - A PILOT STUDY

GOLL, M., SPITZENPFEIL, P., FRÜHSCHÜTZ, H., OLVERMANN, M.
TECHNICAL UNIVERSITY OF MUNICH

Introduction
Sit-skiers cross-block slalom gates by using their body. Consequently, multiple impacts to their upper body and head (protected by full face helmets) can occur. Due to FIS rules a slalom event has to feature a certain number of gates, which is roughly 55 gates per run which equals the amount of possible repetitive head impacts. Additionally, athletes have to cope with daily training volumes of up to 15 runs (á appr. 40 gates). The subject of subconcussive trauma due to repetitive lower intensity impacts has recently come into the spotlight of research due to an increasing number of athletes affected by late damage to their brains in the sports of e.g. football, rugby, boxing (Galgano et al. 2016). The aim of the study is to quantify gate impact of slalom gates to the Sit-skiers' heads. Also, as impact is influenced by the properties of gate material different pole diameters were tested.
Methods
Four elite athletes performed one run in three parallel set slalom courses comprising 25 gates with diameters of 25, 27 and 30 mm. The test device fixed to helmet recorded linear and rotatory acceleration in three axes (2D Datarecording, Germany), and velocity (GPS). Data was processed and analyzed using Matlab R2016a (Mathworks, USA). Resulting linear and rotatory acceleration was calculated. Point of gate contact was identified by separating turns based on gyroscope (located in the seat) signals after signal synchronization. Head-gate-contact was confirmed using video footage.
Results
Maximum values for linear and rotatory acceleration ranged from 14.8 to 19.1 g and 27.1 to 47 rad/s2. No clear difference between pole diameters could be confirmed for linear or rotational acceleration. However, mean linear acceleration of 25mm gates resulted in the lowest head impact values. Mean (±SD) velocity for 25 mm gate diameter was 29.1 km/h (±1.3), 30.3 km/h (±1.6) for 27 mm, and 29.5 km/h (±1.6) for 30 mm.
Discussion
All results remained below reported values measured during attested concussive events (Williams et al. 2016). However, an intensity threshold or maximum number of impacts for sub-concussive does not exist (Tong et al. 2015). Thus, as no threshold can clearly predict any potential late damage, any possibility for a reduction in impact should be investigated, e.g. protective gear that could prevent gate impact to the head in the first place.
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Contact
maren.golltum.de

PARTICIPATION IN PHYSICAL ACTIVITY OF CHILDREN AND YOUTH WITH DISABILITIES

ZUELL, A., TILLMANN, V., ANNEKEN, V.
AFFILIATED TO THE GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Sufficient physical activity (PA) is essential for health and well-being. Some international studies examined the PA pattern of children and youth with disabilities, in Germany this is outstanding. Main research questions were: Do they reach the recommended 10000 steps per day (WHO, 2010) and do they participate in organized sport outside school?
Methods
366 pupils with disabilities wore SenseWear accelerometers for one week and completed questionnaires on their sportive behavior. The amount of steps during and after school on workdays (WD) as well as steps on the weekend (WE) were analyzed, controlling for sex, age-group (g1: 10-14y.; g2: 15-19y.) and severity of impairment and pain.
Results
Overall 51.3% of the sample takes more than 10000 steps on WD but only 35.5% of young women reach this goal. All pupils are highly more active on WD ($p<.001$). 35.6% are members in a sports club, with positive effects on steps/WD in girls and young women (g1: $p=.01$, g2: $p=.011$). Severity of cognitive and visual impairment does not correlate with steps. In girls and young women motor impairment correlates slightly with steps/WD (g1: $r=-.320$, $p=.016$; g2: $r=-.237$, $p=.044$). In younger boys pain has a negative effect on steps/WD ($r=-.212$, $p=.029$). Male participants take more steps/WD than female (mean±sd: g1: 10623±3190 vs. 9672±3221, $p=.034$; g2: 10439±4031 vs. 9167±3524, $p=.045$), which is more pronounced during time in school (g1 and g2: $p<.001$). Differences between age-groups are only significant in females at WE (g1:7006±3277 vs. g2:6020±4375, $p=.024$).
Conclusion
Most participants have a mild to moderate impairment, explaining the small correlation with steps. Most PA is done in school, whereas optional sports in the afternoon or at WE occur comparatively seldom – e.g. 59.7% of german pupils without disabilities are in sport clubs (Manz et al. 2014). More than half of the sample meets the step recommendation of the WHO. Nevertheless, effort should focus on enhancing equal participation in organized sports as it may not only augment PA, but involves many positive factors at the individual and the societal levels. (Kristen et al. 2002).
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Contact
zuell@fi-bs.de

Oral presentations

OP-BN09 Movement variability

DIFFERENTIAL LEARNING APPLIED IN STRENGTH TRAINING FOR WOMEN

BUDIJA, N.C., HEGEN, P., SCHÖLLHORN, W.I.
PARIS LODRON UNIVERSITY

Introduction
The methods of classical strength training have been the same for many years and still mainly rely on Zatsiorsky (1972) and Kusnezow (1975). Nearly in all variants of classical training athletes follow the same unitary advices with correct movement prescriptions and corrections. In contrast fluctuations are exploited in differential learning (DL) not only in technique training (Schöllhorn, 2000), but also in strength training of men (Hegen et al., 2015). The aim of this study is to investigate whether the DL approach is practicable in strength training for women.
Methods
30 healthy and physically active women (22.4 ± 2.3 years) were parallelized in two groups of intervention. They were tested before and after intervention as well as after a retention phase of two weeks for their one repetition maximum (1RM) in squats, bench press, deadlift, rowing, shoulder press and cable crunches. On top they were tested for their performance of Countermovement Jump (CMJ), Squat Jump (SJ), Drop Jump (DJ) and in their throwing performance with a medicine ball. During the intervention both groups trained for 6 weeks twice a week. The classical training group (CG) trained with 90% of the 1RM with 3-5 repetitions. The DL group (DG) trained with approximately 60% of the 1RM but with additional movement variations.
Results
Regarding the 1RM in all exercises the main effect of time ($F2, 42 = 239.63$; $p = .000$; $\eta2 = .919$) and the interaction of time and group ($F2, 42 = 5.22$; $p = .013$; $\eta2 = .199$) showed significant differences. The observed effect size was high and medium. No differences were identified statistically between both groups ($F1, 21 = .000$; $p = 1$; $\eta2 = .000$). The results for all jump-tests are not significant. A significant effect of time for the SJ can be observed ($F1, 27 = 20.13.$; $p =.000$; $\eta2 = .427$). Significant results were assessed for the throwing-tests regarding the factor time ($F1, 27 > 9.26$; $p <.005$; $\eta2 > .249$). All other results are not significantly.
Discussion
Both groups increased highly significant their 1RM performance. It is remarkable that the DG can realize this increase with a lower intensity and that these effects also last over a time without any strength training contrary to the CG. Both groups enhanced their jumping heights only for the SJ. Also the throwing performance improved for both groups. The results encourage for rethinking the existent strength training philosophies.
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Contact
n.budija2106@googlemail.com

TOWARDS THE CONTROL OF MINIMAL TOE CLEARANCE IN WALKING

HAMACHER, D., SCHEGA, L.
OTTO-VON-GUERICKE-UNIVERSITÄT MAGDEBURG

Introduction
Tripping is a primary cause for falls during walking. At minimum toe clearance (MTC), the likelihood to experience a trip-related fall is considered to be highest. Controlling MTC, as quantified with its stride-to-stride variability, reflects the principle characteristic regarding the ability to negotiate external surface-related perturbations which is essential for walking without tripping. According to the optimal feedback control theory, people tend to only modify variability in any given task if it interferes with the task performance (Todorov and Jordan, 2002). Therefore, the central nervous system might give priority to an accurate reduction of the variability in MTC as compared to other gait parameters. The first purpose of this study was to evaluate if older individuals show a lesser increase in the variability of MTC during a dual-task condition (where an increase of gait variability is provoked), while allowing a larger range of variability in the other gait parameters. The second purpose of the study is to evaluate if a motor-cognitive intervention program (dancing) would improve MTC control to a higher extent than the control of other gait parameters.
Methods
Study 1: Forty elderly participants walked back and forth on a 25 m long track for five minutes. They then walked a second time performing an additional cognitive task. The variability in stride time, stride length and MTC were calculated for each walk. Group differences between normal walking and dual-task walking were compared with the Wilcoxon-test. Study 2: Thirty-five older adults were assigned to a dancing group or a health-related exercise group. In pre-test and post-test, we assessed the variability of all three gait parameters which were analysed with two-way repeated-measures ANOVAs (group x time) for each tested dependent variable.
Results
Study 1: The variability of MTC did not change during dual task-walking. The variability of stride length and stride time increased about 66% and 84%, respectively ($p = .000$ for both parameters). Study 2: Only in the variability of MTC, we found an interaction effect (group x time: $F1,33 = 4.299$, $p = .042$; $\eta2 = .060$), indicating that dancing lowers gait variability to a higher extent than conventional health-related exercise.
Discussion
Our data suggest that MTC is controlled with high priority. Evaluating MTC variability may, therefore, add information about gait control which goes beyond the information one can deduct from other gait parameters' variability. We believe that the variability of MTC might be a strong indicator estimating the risk of falling in frail people or patients with neurologic disorders. Fortunately, MTC control can be improved by a dancing programme which might prevent future falls due to tripping.
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Contact
dennis.hamacher@ovgu.de

IS THERE A DIFERENCE IN THE CONTROL OF THE DOMINANT LEG COMPARED TO THE NON-DOMINANT LEG?

PROMSRI, A., HAID, T., FEDEROLF, P.
UNIVERSITY OF INNSBRUCK

Introduction
The scientific literature reveals an interesting paradox about leg dominance: a difference in task performance between dominant and non-dominant leg is well established, however, motor control variables usually do not differ (Alonso et al., 2011). Hence, better performance suggests different control, yet the conventional variables for motor control are not sufficiently sensitive to explain the leg dominance from a motor control perspective. In the current study, we investigated leg dominance in one-leg balancing. We hypothesized that leg dominance emerges from a difference in the composition of postural movements or from a difference in how often postural movements are corrected by the neuro-muscular system.
Methods
The dominant leg was defined as the preferred kicking leg. The balancing motion of 26 active adults (age 25.3 ± 4.2 yrs, weight 70.7 ± 11.4 kg, height 175.0 ± 8.1 cm; mean ± standard deviation) performing a one leg stance was recorded using 39 markers and a motion capture system (Vicon, Oxford, UK). The 3D-marker data was analysed by a principal component analysis (PCA), then postural accelerations (PA_k) of the postural movement components (PM_k) were calculated (Federolf, 2016). Here k denotes the order of the PM. The relative postural variance in each PM (Var_k) was analysed to determine differences in the composition of postural movements. The number of zero crossings in PA (N_k) served as a variable to test for differences in how often the postural movements were corrected.
Results
No difference between dominant and non-dominant leg were found in the Var_k. However, in significant differences were observed in N_1 (p=0.003), N_2 (p=0.002) and N_3 (p=0.02). Interestingly, when standing on the dominant leg, N was smaller in PM1 and PM3, but larger in PM2.
Discussion
The current study indicated that there is no difference in the composition of postural movements between standing on the dominant or non-dominant leg. However, there is a difference in how postural movements are controlled, specifically, in how often the acceleration of postural movements changes direction. We hypothesize that the observed differences between N_1/N_3 and N_2 might be explained by how difficult it is to control these PMs and by the "Minimum Intervention Principle" (Todorov and Jordan, 2003). In many sports performance and injury risk depend substantially on leg dominance. The current study contributes to the understanding of leg dominance from a neurophysiological point of view.
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Contact
arunee.promsri@student.uibk.ac.at

THE EFFECT OF ISOTROPY BIAS FOR OWN MOTOR VARIABILITY ON AIMING POINT IS LIMITED

YAMAMOTO, H., SHINYA, M., ONAGAWA, R., KUDO, K
THE UNIVERSITY OF TOKYO

Introduction
Knowing own motor variance is important for motor decision making. Previous studies demonstrated isotropy bias (estimating own motor variance at approximately-circular distribution rather than vertically elongated true distribution) in reaching task (Zhang et al., 2013). Due to this incorrect estimation for own motor variance, aiming could be suboptimal. Therefore, this study investigated whether the participants aim suboptimal point based on isotropy bias.
Methods
Nine participants executed a reaching task using a pen tablet (Intuos4 PTK-1240, Wacom, Japan) and Psychophysics Toolbox (Brainard, 1997) in MATLAB 2016b (MathWorks, USA). First, the participants recognized own motor variance through practice phase (50 trials). Second, they reached the gain area in the test phase (50 trials). The gain depended on the distance from the bottom right of the square gain area to the endpoint (0 point at the bottom right and 100 point at the top left). We instructed participants to maximize total score of the set. There are two conditions for moving directions (0 degree: straight, -45 degree: cross). We simulated theoretically optimal aiming point (TOA) and gain (TOG) based on their observed variance. We calculated TOG by multiplying probability density function and gain function. We defined the distance from the observed mean endpoint to TOA as the dissociation distance (DD). We also defined the ratio of observed gain to TOG as optimality of gain (OG). We compared the DD and OG between conditions.
Results
DD were 19.31 (±9.30) and 25.39 (±15.72) pixels in cross and straight condition, respectively. There was no significant difference between conditions ($t(8) = 1.29$, $p > .05$). OG were .951 (±.06) and .934 (±.06) in cross and straight condition, respectively. There was no significant difference between conditions ($t(8) = 0.70$, $p > .05$).
Discussion
In this study, we couldn't find negative effects of isotropy bias on aiming. We set a gain function that could affect optimal aiming point depending on start point if they have isotropy bias, but there was no significant difference in the aiming point between the conditions. As a reason for this, internal representation of own motor variance should be not fully used for aiming. For example, Aglioti et al (1995) showed the dissociation between perception and action. For future study, we will examine the components of motor planning by make participants estimate own motor variance.
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Contact
hyamamoto.mcml@gmail.com

VARIABLE INERTIA TRAINING: OPTIMIZATION OF EXPLOSIVE-POWER EXERCISES WITH ROBOTIC-RESISTANCE STRENGTH MACHINES

BISCARINI, A.1, BENVENUTI, P.2, CONTEMORI, S.1, CUZZOLIN, F.3

1: UNVERSITY OF PERUGIA (ITALY), 2: UNIVERSITY OF VERONA (ITALY), 3: UNIVERSITY OF PADOVA (ITALY)

Introduction
Strength training machines with computer-adjustable resistance mechanisms can simulate external resistance of different kinds (gravitational, elastic, viscous, etc.) and magnitude R, and different levels of inertial force (the product of the resistance mass m and its acceleration). Notably, the simulated levels of R and m can be freely adjusted, during movement, independently of each other.
Methods
We have performed a numerical simulation of exercises for explosive power to analyze the kinematic and kinetic effects of resistances that combine different levels of R and m, i.e., different levels of external resistance and inertial force.
Results
A progressive increase in m gradually enhances the peak user's force and reduces the peak acceleration at all resistances R, enhances and shifts later in time the peak power at low resistances, and reduces the mean power at high resistances. The mass m also induces a rate of force development (RFD) at the beginning of movement in a timeframe which becomes progressively longer with higher values of m. Complete lack of mass m would be needed in the final phase of the movement to attain an effective training stimulus for high-velocity strength.
Discussion
The results allow the determination of the optimal combination of R and m that maximizes the peak power within a specific time frame from the onset of movement. This information is of relevance in sports training, given the critical role of explosive power in many sports activities, and limited time available to perform several explosive athletic movements (typically less than 0.3 s). The results also suggest a new training method for explosive power, called "Variable Inertial Training", which is based on the use of strength machines that use a motor and an electronic management system to simulate variations in resistance mass m (and external resistance force R) in response to the kinematic parameters (position, velocity, and acceleration) of movement. The simulated levels of external resistance and inertial force can be adjusted independently from each other, during movement to closely reproduce the kinematic and kinetic patterns occurring during ballistic or explosive sport movements, such as those occurring during throwing, hitting, rowing and pushing activities. In addition, it may potentially enable the integrated development of the main neuromuscular components (force, RFD, and high-velocity strength) that contribute to the expression of explosive power for sports performance.
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COMPARING A MOVEMENT AND SKILL ADAPTABILITY PROGRAM TO A CONVENTIONAL TENNIS TRAINING PROGRAM

POTTER, A.1, BERRY, J.1,2, ZOIS, J.1

1: VICTORIA UNIVERSITY (MELBOURNE, AUSTRALIA), 2: MARIBYRNONG SPORTS ACADEMY (MELBOURNE, AUSTRALIA)

Introduction
The two most reported development pathways are early sport specialisation (ESS) and sport sampling (SS). ESS requires focusing on one sport from a young age; accumulating a greater number of sport-specific practice hours (Mostafavifar, Best, & Myer, 2013). Contrastingly, SS promotes a period of multi-sport involvement providing a broad range of motor control experiences (Côté, 1999). Novice tennis players often experience an ESS approach hindering multi-dimensional development (physical, technical, tactical, psychological) (Gonzalez & Ochoa, 2003). Movement and skill adaptability can act as the intermediary pathway, maximising the benefits of each and minimising the risks. The aim of this research was to compare an adaptability training program to a conventional tennis training program.
Methods
Participants (n=49) were randomly assigned to intervention or control groups and received 12 weeks of training, with pre, mid and post-testing. The intervention group received 1 session (45 minutes) of adaptability training and 1 session of conventional tennis training per week, whilst the control group received 2 sessions per week of conventional tennis training.
Results
Both groups reported similar baseline performance ($p>0.05$) and demonstrated significant improvement at post-test across a number variables tested. Only the intervention group improved significantly in a timed tennis specific accuracy task and reported higher levels of enjoyment than the control group.
Discussion
In the applied setting, coach led, highly repetitive tennis based training has dominated (Reid, Crespo, Lay, & Berry, 2007). Increased variability will provide greater benefit to the developing athlete than the more commonly accepted prescriptive coaching (Reid et al., 2007). Movement and skill adaptability is representative of the increased variability described by Reid et al. (2007) and results demonstrate improved tennis performance as well as increased enjoyment. Adaptability serves as a potential intermediary between ESS and SS, performing a high level of domain specific practice whilst manipulating constraints to ensure a high level of variety. Longitudinal research should evaluate the effectiveness of movement and skill adaptability as a development pathway.
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Contact
Aaron.Potter@vu.edu.au

Oral presentations

OP-BN01 Motor Control: Skill acquisition

PRACTICING A MOTOR SKILL WITH ONE HAND DISRUPTS EARLY CONSOLIDATION OF ANOTHER SKILL PREVIOUSLY ACQUIRED WITH THE OTHER HAND

RUFFIEUX, J., KELLER, M., TAUBE, W.
UNIVERSITY OF FRIBOURG

Introduction
Practicing a new motor skill with one limb can lead to improvements not only in the trained but also in the untrained limb – an effect known as bilateral transfer (Lee & Carroll, 2007). However, consolidation of the skill can be disrupted if a second skill – involving homologous muscles of the same limb – is practiced immediately afterwards (Lundbye-Jensen et al., 2011). Interestingly, such interference effects are also transferred to the untrained limb (Lauber et al., 2013). The present study is the first to look at the effect of practicing a second task using the untrained hand on bilateral consolidation of the first task.
Methods
48 young adults were randomly allocated to one of four groups. They all practiced a ballistic motor task (task A) involving the wrist flexors of their dominant hand followed immediately by practice of a visuomotor tracking task (task B) that involved the wrist flexors (homologous muscles) or extensors (antagonistic muscles) of the trained (groups 1 and 2) or the untrained hand (groups 3 and 4). We measured performance improvements and bilateral transfer in task A as well as bilateral retention of task A after practicing task B.
Results
Analysis showed that all groups improved significantly and to a similar extent in task A with their trained hand (+ 19 %) and that these improvements were almost completely transferred to the untrained hand (+ 17 %). Also for task B, significant and similar improvements were found in all groups. Results of the retention test in task A showed that the two groups that performed task B using the flexor (homologous) muscles of either the trained or the untrained hand experienced significant interference (- 8 %, $p < .001$). Interestingly, these interference effects were similar in the trained (- 10 %) and the untrained hand (- 5 %). In contrast, the two groups practicing task B with the antagonists showed nonsignificant bilateral improvements during retention (+ 4 %, $p = .130$).
Discussion
Our results provide evidence that early motor memory consolidation of a task practiced unilaterally is disrupted in both hemispheres if a different motor skill engaging homologous muscles is learned shortly afterwards – this is true whether the interfering task is practiced with the previously trained or untrained hand. This suggests that unilateral practice can provoke both beneficial and "detrimental" neural reorganization in both hemispheres – a finding that supports the "cross-activation" hypothesis to explain bilateral transfer.
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Contact
jan.ruffieux@unifr.ch

EFFECTS OF REAL-TIME AUDITORY FEEDBACK ON PROPRIOCEPTIVE ACCURACY

GHAI, S., SCHMITZ, G., HWANG, T., EFFENBERG, A.O.
LEIBNIZ UNIVERSITY

Introduction
A real-time kinematic-auditory feedback of performance via sonification allows enhanced multisensory integration for efficient motor performance (Effenberg et al., 2016). Proprioception as an integral component of central body scheme could be possibly modulated by such additional feedback as suggested by (Effenberg et al., 2016). Understanding the functionality of the proprioceptive system under such influences can allow to develop efficient rehabilitative and performance enhancing maneuvers (Sober and Sabes, 2005), such as gymnastics. The study aimed to evaluate the effects of real-time, kinematic-auditory feedback on knee proprioception, under higher and lower information processing constraints.
Methods
Thirty healthy participants were randomly divided in experimental (24.2±3.7 years) and control (23.5±2.5 years) groups. Active joint knee repositioning trials were performed by participants for two different target angles in three different conditions: I) without feedback, II) with auditory feedback, III) with auditory feedback while performing a non-verbal backward counting visual memory task. Participants performed 15 repetitions for each angle in each condition. Repositioning errors were computed in accordance to Ghai et al. (2016), using an IMU based motion detecting equipment XSENS®. A three-way ANOVA for Group x Angle x Condition were performed. Post hoc analysis was computed using Newman-Keuls method.
Results
Statistical analysis revealed significant main effects of group ($F1,28=4.41$, $p=0.045$, $Eta^2=0.14$) and condition ($F6,128=11.60$, $p<0.001$, $Eta^2=029$) as well as a significant interaction Condition*Group ($F6,168=5,68$, $p<0.001$, $Eta^2=0.17$). Post hoc decompositions confirmed significant enhancements in knee repositioning accuracy (2.36°±0.57°) when real-time auditory feedback (1.29°±0.37°) was provided, under both higher (1.30°±0.56°) and lower information processing constraints.
Discussion
Participants increased accuracy with the auditory input and the accuracy benefit diminished once the auditory feedback was removed (2.40°±1.20°). The presence of a dual-task condition allowed significant enhancements in both the absence and presence of acoustic feedback. Thus, this study is the first to reveal enhanced precision of motor judgments with additional kinematic-acoustics inputs. In future research, we hypothesize that modulation of acoustics might possibly allow compensatory adaptations in motor behavior.
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SURROUND INHIBITION IS INSTANTLY MODULATED BY CHANGING THE ATTENTIONAL FOCUS

KUHN, Y., KELLER, M., LAUBER, B., TAUBE, W.

UNIVERSITY OF FRIBOURG

Introduction

By inhibiting the cortical excitability of surrounding brain networks, motor surround inhibition (SI) shapes the neural drive of the primary motor cortex (M1) during voluntary movements [5] and is therefore considered to be essential for skilled motor behaviour [1]. However, how surround inhibition can be modulated remains largely unclear. Some studies show that SI increases after learning a task [6] while others demonstrated reduced SI in well-trained experts (e.g. musicians) [4]. Nonetheless, as it was recently shown that adopting an external (EF) contrasted to an internal focus of attention (IF) could instantly enhance intracortical inhibition [3], the aim of the present study was to investigate the immediate effects of different attentional strategies on SI.

Methods

After testing for Fmax with EF, IF and a neutral focus of attention (experiment 1), subjects (n = 14, 22-35 y) were asked to reach a target line representing 10% of the Fmax by pushing with the index on a force plate after a tone (experiment 2). Before each series, subjects were asked to concentrate on their finger (IF) or to concentrate on the force plate (EF). During the motor task, TMS was randomly delivered over M1 at 4 different time points: rest, premotor, phasic and tonic. The motor evoked potentials (MEPs) were recorded from two muscles: the FDI (prime mover) and the APB (surrounding muscle) and were compared at the premotor and phasic phases, as SI was only expected at these two time points [1].

Results

In experiment 1, Fmax was significantly enhanced with EF compared to IF (+15%, $p < 0.001$). In experiment 2, MEPs in the APB were significantly reduced (-27%, $p = 0.004$) during the premotor phase when adopting an EF contrasted to an IF, indicating more SI. When looking at the background EMG of the APB before brain stimulation, no significant differences were found.

Discussion

For the first time we showed that SI can be instantly modulated by adopting different attentional foci. Most importantly, the current study showed that SI in the surrounding muscle APB can be increased with EF and leads to better motor performance. Interestingly, a typical clinical feature of a reduced SI can be found in focal hand dystonia (FHD) patients [2], leading to unusual co-contractions and abnormal motor execution. Thus, in a clinical context, EF might be efficient to counteract FHD. In conclusion, this study does not only help to better understand the mechanisms behind the beneficial role of EF but may also point towards a treatment strategy in patients with disturbed SI.

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Contact

yves-alain.kuhn@unifr.ch

THE EFFECT OF ATTENTIONAL FOCUS ON MINDFULNESS DURING A 6-WEEK BALANCE EXERCISE TRAINING PROGRAM IN YOUNG ADULTS

PANTANO, K., GENOVESE, J.E.C.

CLEVELAND STATE UNIVERSITY

Introduction

Mindfulness, or present moment awareness, is purported to benefit motor control and learning (Kee, 2012, Brown, 2003). Motor learning is thought to be enhanced when concentration or attention during exercise training focuses on an external goal (engaging automatic control processes) vs. attention to body position and movement (requiring conscious control and less automaticity) (Wulf, 2004, 2001). Exercises aimed at improving balance may incorporate an internal or external focus of attention (IFA or EFA), but it is not known how balance training and type of instruction received during balance training affects mindfulness. The purpose of this study was to determine whether balance exercises improve mindfulness and if mindfulness is influenced by the type of instruction received during balance training.

Methods

Sixty-three physically active college students with no history of musculoskeletal injury in the last year and no surgeries in the last 5 years were recruited. Group 1 (n = 33; 24.8 ± 3.2) received a 6 week balance exercise training program consisting of 8 progressive static and dynamic balance exercises instructed with an internal focus of attention (IFA). Group 2 (n =30; 24 ± 3.8) received the same intervention, but were instructed with cues using an external focus of attention (EFA). The Freiburg Mindfulness Inventory (FMI) (Walach 2006) was used to assess mindfulness at baseline (initial), and 6-weeks (final) following the exercise intervention. Paired sample t-tests were used to assess change in FMI scores from baseline to 6 weeks ($p < 0.05$).

Results

Baseline FMI scores between Group 1 (IFA) and Group 2 (EFA) were similar (41.6; 41.3 respectively; $P > .05$). At 6-weeks, subjects receiving IFA instruction exhibited a greater degree of mindfulness, as indicated by an increase in FMI score, compared to baseline (17.5 points, 95% CI, -21.5, -13.4, p=0.0000). Subjects receiving EFA instruction also improved degree of mindfulness at 6-weeks, compared to baseline (1.74, points, 95% CI, -3.2, -.21, P=.027), but the magnitude of improvement (effect size) was much smaller than seen in the IFA group.

Discussion

The results indicate that mindfulness can be improved with a balance exercise intervention; however, providing an IFA during instruction may be more effective than providing an EFA during instruction. Increasing mindfulness via balance training may require more body awareness and conscious control, therefore promoting an IFA may be desired. More research is needed to elucidate the relationship between mindfulness, motor learning and attentional focus strategies. Practitioners should consider that balance exercise training can effect degree on mindfulness, and that the type of instructional strategy employed may influence results.

MOTOR VARIABILITY IN DIFFERENCIAL LEARNING COMPARED WITH LOW, INCREASING AND HIGH CONTEXTUAL INTERFERENCE IN A BASKETBALL TASK

BECKMANN, H., HORST, F., SCHÖLLHORN, W.I.

JOHANNES GUTENBERG-UNIVERSITY MAINZ

Introduction
Several phenomena and explanations for motor learning like contextual interference (CI; Battig, 1966) can be integrated into the differencial learning approach (DL; Schöllhorn, 2000; Schöllhorn et al., 2006). The basis for this unifying theory is the assumption that the amount and structure of motor variability during acquisition is responsible for the initiation of the learning process. Despite its important role in this framework only a few studies quantify motor variability in DL and other learning protocols like CI (Wagner & Müller, 2008). Therefore the aim of the study is a biomechanical comparison of motor variability in DL and other variation oriented learning protocols in a basketball task.
Methods
Five experienced basketball players (male, M age=23.6 years, SD=1.0) performed three different basketball passes (chest, overhead, single arm) under four conditions: Blocked CI, Increasing CI (Porter & Magill, 2010), Random CI and DL. On one day the participants performed 45 passes (15 trials of each pass) in each condition from a 5-m-distance on a target (180 passes total). The order of conditions was counterbalanced across participants. There was a 30 minute rest period between the conditions. Time continuous kinematic data (Qualysis Oqus 310; 250 fps) was recorded from upper body. The coefficient of variation of joint angles was calculated in order to compare motor variability between conditions using an ANOVA with subsequent post hoc pairwise comparisons.
Results
The statistical analyses showed a significant global effect ($F(3;16)=60.679$, $p<.001$; partial Eta-squared=.919). Post hoc analysis revealed a significantly higher motor variability in DL compared to all CI conditions ($p<.001$ and Eta-squared>.909 for all pairwise comparisons). No statistical differences could be found between the three CI conditions.
Discussion
The present results showed that the movement variability in DL is up to three times higher than in CI and confirm the theoretical framework of DL by means of biomechanical variables (Schöllhorn et al., 2006). Taking the results from Beckmann et al. (2015) in account it seems that this amount of variability in DL compared to CI is more beneficial for motor learning. Moreover, the results do not confirm the idea of an increasing learning schedule (Porter & Magill, 2010).
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Contact
hendrik.beckmann@uni-mainz.de

Oral presentations

OP-PM16 Training in kindergarten and school

PROFILING MOVEMENT QUALITY, MOTOR COMPETENCE AND GAIT CHARACTERISTICS IN 3-5 YEAR OLD CHILDREN

CLARK, C.C.T.1, BARNES, C.2, SWINDELL, N.2, BINGHAM, D.3, COLLINGS, P.3, BARBER, S.3, SUMMERS, H.2, MACKINTOSH, K.2, STRATTON, G.2

1:HARTPURY UNIVERSITY CENTRE, 2: SWANSEA UNIVERSITY, 3:BRADFORD INSTITUTE FOR HEALTH RESEARCH

Introduction
There is a dearth of suitable metrics capable of objectively quantifying competence levels. Further, objective movement quality characteristics during free-play have not been investigated in early years' children. The aims of this study were to characterise children's free-play physical activity and, investigate how movement quality characteristics of gait cluster with free-play in children (3-5y).
Methods
Sixty-one children (39 boys, 4.3±0.7y, 1.04±0.05m, 17.8±3.2kg, body mass index; 16.2±1.9 kg.m2) completed the movement assessment battery for children and took part in free-play whilst wearing an ankle-and hip-mounted accelerometer. Characteristics of movement quality were profiled using a clustering algorithm. Spearman's who was used to assess relationships between movement quality characteristics and the Mann-Whitney U test was used to assess motor competence classification differences in integrated acceleration and spectral purity.
Results
Significant differences were found between motor competency classifications for spectral purity and integrated acceleration ($p<0.001$). Spectral purity was hierarchically clustered with motor competence and integrated acceleration. Significant positive correlations were found between spectral purity, integrated acceleration and motor competence ($p<0.001$).
Discussion
This is the first study to report spectral purity in early years' children and our results have demonstrated that the underlying frequency component of movement is clustered with motor competence.
Contact
cain.clark@hartpury.ac.uk

THE IMPACT OF SUMMER HOLIDAYS AND SCHOOL DEPRIVATION INDEX UPON CARDIORESPIRATORY FITNESS LEVELS IN PRIMARY SCHOOL CHILDREN

MANN, S.1,2, WADE, M.1,3, SANDERCOCK, G.4, BEEDIE, C.1,5

COVENTRY UNIVERSITY

Introduction
Decreasing physical activity (PA) among schoolchildren is a public health issue. Whilst cardiorespiratory fitness (CRF) is a validated marker of PA, little systematic measurement of this variable is conducted in school children. The primary purpose of this investigation was to examine the CRF of children at a number of UK primary schools over one academic year. Measures were CRF as evidenced through the 20m shuttle run test (20-mSRT) and body mass index (BMI).
Methods
Children aged 9-10 years (n=409 222 male; M±SD Height;1.32±0.06m, Weight;30.75±7.15kg), from 13 primary schools completed a 20-mSRT four times during a calendar year including either side of Summer holidays (Autumn 2014, Spring 2015, Summer 2015, and Autumn 2015). Data collection was conducted by qualified personnel already operating in the schools.
Results
BMI z-score differed statistically significantly between time points (F (2.376, 969.352) =6.506, p=0.001). Post hoc tests revealed a statistically significant decrease in BMI z-scores from Autumn 2014 to Spring 2015 (mean diff = -0.083, p=0.016) and statistically significant increases from Spring 2015 to Summer 2015 (mean diff = 0.080, p=0.006). Significant differences in fitness z-score between time points were shown (F (2.872, 1171.689) =49.559, p<0.000), with post hoc test revealing an increase in fitness z-scores from Autumn 2014 to Spring 2015 (mean diff = .271, p<0.000) and decrease between Summer 2015 and Autumn 2015 (mean diff =-.291, p<0.000). ANOVA demonstrate statistically significant effect of deprivation quartile for fitness z-scores (F(2,406) = 4.849, p=.008). CRF decrease was significantly (p<0.05) greater in the most deprived quartile than the least.
Discussion
The present study suggests that the systematic measurement of children's CRF is both feasible and scalable. Such data would inform policy positions and the allocation of funding into interventions targeting the physical activity of primary age children. Data highlight dramatic and significant reductions in children's fitness levels over the summer holiday period – an effect which is significantly more apparent among children from the most deprived areas.
Contact
stevenmann@ukactive.org.uk

COMPARISON OF THREE METHODS OF PHYSICAL ACTIVITY TRAINING ON BODY COMPOSITION, PHYSICAL FITNESS FACTORS AND BLOOD PRESSURE AMONG OVERWEIGHT OR OBESE PRIMARY SCHOOL GIRLS

ZIDASHTI, Z.

ISLAMIC AZAD UNIVERSITY

Introduction
The aim of this study was to compare three methods of physical activity training on body composition, physical fitness factors and hypertension among overweight or obese in primary school girls.
Methods
The study population were selected 120 female students aged 11.25 ± 0.80 years, height: 150.38 ± 8.76 cm, weight: 58.01 ± 10.23 kg, and body mass index (BMI) 25.53 ± 3.05 kg m through non-probability sampling were divided into four groups composed physical activity training by speech, physical activity training by booklet, physical activity training by practical exercises as well as a control group. Each group consisted of 30 patients whose were evaluated for 8 weeks. First, participants were tested for thickness of subcutaneous fat, body mass index, abdominal circumference, resting hypertension and cardio-respiratory endurance tests, muscular endurance and flexibility. Then, a training course of physical activity took place in each groups separately (First group: physical activity training by speech, the second group: physical activity training by booklet and and the third group: physical activity training by practical exercises). During the eight-week, the control group was not involved in any of the training programs. At the end, the variables were measured once again under the same conditions in the pre-test.
Results
The findings showed that, in physical activity training by practical exercises, BMI was decreased, and muscular endurance and cardio-respiratory endurance were increased during the course as a result of comparing what was measured before in a pre-test ($p \leq 0.05$). In the group of physical activity training by speech, thickness of subcutaneous fat abdominal circumference and systolic hypertension were reduced, and cardio-respiratory endurance was enhanced in post-test rather than pre-test ($p \leq 0.05$). BMI and systolic hypertension were decreased in the post-test compared to the pre-test in the physical activity training by booklet ($p \leq 0.05$). In the control group BMI and cardio-respiratory endurance were decreased in the post-test than the pre-test ($p \leq 0.05$). There was a significant difference among experimental and control groups in terms of BMI and muscular endurance ($p \leq 0.05$). There was a significant difference regarding the thickness of subcutaneous fat in physical activity training by speech and the other groups ($p \leq 0.05$). As well as, in comparison of systolic hypertension there was a significant difference between the physical activity training by booklet and the control group ($p \leq 0.05$).
Discussion
The results indicated that since, attitude change can also create behavior change, thus, the use of methods of physical activity training at school and perform recommended and provided education to children and adolescents caused to improve body composition, increase the efficiency of some elements of physical fitness and reduce resting hypertension in children and adolescents with overweight and obesity.

THE SPORT EXPERIENCE AND BALANCE CONTROL: A DEVELOPMENTAL PERSPECTIVE

OLIVEIRA, A.1, GALLAGHER, J.D.2, OYEN, A.S.3

STATE UNIVERSITY OF LONDRINA

Introduction

This study investigated the relationship between a motor skill postural and action components and balance while moving. The experience examined the influence of experience on the development of balance control strategies (stabilization of the head in space) during locomotion given varying levels of task complexity.

Methods

The design of the study was age (6-, 12-, 19-years) x experience (gymnast, non-gymnast) x surface (floor, beam) x obstacle (absent, present), with repeated measures on the last three factors. The dependent variables were root mean square (RMS) and index of smoothness (IS) of the head and trunk. The alpha level was set at $p<0.05$. To qualify as a gymnast the individual had at least two years of experience. There were 10 subjects in each age x experience group. The hypothesis was that the younger gymnasts would stabilize their heads in space in a manner similar to the older subject but with increases in complexity the young gymnasts would respond similarly to their age group peers. Subjects walked across a line and on a balance beam both with and without an object in the path for five trials. Triaxial accelerometers were placed on the head, hips and ankle.

Results

The results indicated that age differences existed for the non-gymnasts but not the gymnastic group. The gymnasts changed their trunk and ankle motion in preparation to walk over an object whereas the non-gymnasts did not. When walking over the object the gymnasts stabilized their heads.

Discussion

There was support for sport experience influencing the development of a stabilization of the head in space strategy. The adults demonstrated trunk stability regardless of strategy. The sport experience influenced balance control across age and task complexity levels.

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FEASIBILITY AND EFFECTIVENESS OF A PHYSICAL ACTIVITY INTERVENTION DURING RECESS IN PRIMARY SCHOOL

CASOLO, A.1,2, BILATO, M.2, BIANCO, M.2,3, GALVANI, C.2

1. UNIVERSITÀ DEGLI STUDI DI ROMA FORO ITALICO; 2. UNIVERSITÀ CATTOLICA DEL SACRO CUORE, MILANO, ITALIA; 3. FONDAZIONE POLICLINICO A. GEMELLI/UNIVERSITÀ CATTOLICA DEL SACRO CUORE, ROMA, ITALIA

Introduction

Promoting physical activity (PA) in younger children is a major public health priority (1). In the last years, many interventions aimed to increase PA levels without sacrificing time spent in academics (2). The aim of this study was to examine whether the introduction of four traditional Italian games of known energy expenditure (>6 METs) during structured recess was associated with higher rates of children's PA at the end of the intervention.

Methods

One hundred 2nd and 3rd grade children (age, 7.5±0.5yr; height, 1.26±0.7m; weight, 29.3±5.9kg) of two different schools participated in this study. The intervention (INT) school underwent 15 min of structured and physically active recess, 4 times per week for a duration of 12 weeks. The control (CON) school carried out a 15 min unstructured free-play recess. PA daily levels (step counts, steps/day; moderate-to-vigorous PA (MVPA), min/day) were monitored consecutively for 7 days both at pre- and post-intervention through accelerometry. Only recordings including a minimum of 10 hours per day for at least 3 weekdays (WD) and 1 weekend day (WE) were considered in the final analysis (3). A multivariate analysis of variance with a 2x2 factorial design was performed. Significance level was set at $p<0.05$.

Results

After 12 weeks, no significant time x group interaction was observed. However, both schools improved the steps counts during WD (INT: 10445±2843 vs. 12372±3560; CON: 10174±3292 vs. 10344±1857, steps/day, $p=0.001$) and during WE (INT: 10363±3578 vs. 11290±4792; CON: 10048±3943 vs. 11945±4016, steps/day, ns). Moreover, the INT school increased MVPA during both WD (39.8±19.0 vs. 47.1±22.0, min/day) and WE (33.3±20.2 vs. 39.4±25.9, min/day), although not significantly; the CON school slightly improved the MVPA during WE (30.5±16.3 vs 38.3±20.0, min/day) but decreased MVPA during WD (35.1±11.1 vs 33.6±9.2, min/day).

Discussion

The school-based intervention proposed, which consisted in the inclusion of a physically active recess without changing normal time schedules and sacrificing time spent in academics, proved to be feasible and easy to implement in a primary school context. Nevertheless, in contrast to a previous study (4), the results of this analysis highlighted that implementing a PA intervention for a total of 60 min per week was not sufficient to significantly enhance children's PA daily levels.

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Contact

a.casolo@studenti.uniroma4.it

Oral presentations

OP-SH01 Cognition and Wellbeing

EFFECT OF HIGH-GROOVE MUSIC COMBINED WITH MILD EXERCISE ON MOOD AND EXECUTIVE FUNCTION

FUKUIE, T., SUWABE, K., OCHI, G., SOYA, H.
UNIVERSITY OF TSUKUBA

Introduction
Physical exercise has beneficial effects not only on peripheral function, but also on the brain. Acute physical exercise elicits increased activation in the dorsolateral prefrontal cortex (DLPFC) and improved executive function (Byun et al., 2014). In order to enhance the exercise effect, we focused on groove, which is the experience of wanting to move one's body when listening to music, and which is closely linked to positive emotions. Groove is highest when the degree of syncopation is medium (Witek et al., 2014). Since positive moods are associated with better executive performance, we hypothesized that exercise combined with high-groove music may enhance exercise effects on mood and executive function.
Methods
We arranged two types of drum music which differed in their degree of syncopation. One had a rhythm with a medium degree of syncopation (MS-music), and the other with a high degree of syncopation (HS-music). Forty-four young, healthy participants listened to the drum music and assessed their mood and groove (Exp. 1). Next, participants (N=24) performed 10 minutes of mild (30% VO2peak) or moderate (50% VO2peak) exercise while listening to HS- or MS-music, and assessed their mood change (Exp. 2). Third, participants (N=19) underwent two experimental conditions: 10 minutes of mild exercise with MS-music or without music. Before and after exercise, a color-word Stroop task was conducted and task-related prefrontal activity was measured using multichannel fNIRS (Exp. 3).
Results
In Exp. 1, we confirmed previous findings that MS drum music elicits a high groove and positive valence. In Exp. 2, we determined that MS-music enhanced valence with 10 minutes of mild exercise, but not with moderate exercise. In Exp. 3, MS-music enhanced the positive effects of mild exercise on mood, but not on executive function. We hypothesized that individual differences in sensitivity to and confidence in the rhythm may have affected the effects. Thus, we divided the sample into two groups (the positive group (N=9) and the negative group (N=10)), and found that MS-music strengthened the effects of exercise on executive function in the positive group.
Discussion
We presume that the negative group had to pay extra attention to the beat in exercise with high-groove music, which reduced their mental resources including attention and cognition, resulting in unaltered executive function. These results suggest that high-groove music could enhance exercise-induced mood changes, but that individual differences in sensitivity to and confidence in the rhythm may influence its effect on executive function.
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THE INTERACTIVE EFFECT OF WANTED, REQUESTED AND RECEIVED SOCIAL SUPPORT ON SUPPORT SATISFACTION AND AFFECT

FU, D., FREEMAN, P.
UNIVERSITY OF ESSEX

Introduction
The presence of supportive relationships can play a crucial role in sporting contexts yet the actual receipt of supportive behaviours from these relationships is sometimes ineffective. This paradox may be explained by the degree of congruence between the support wanted and received, and also the amount of support requested. This study therefore examined the interactive effect of wanted, requested, and received support on positive and negative affect, and whether these interactive effects were mediated by satisfaction with support.
Methods
Two hundred and ninety-six university athletes (108 females, Mage = 21.7, SD = 3.3 years) reported the amount of support they wanted for the upcoming week, along with their affect one week before a competition. One day before competition, participants reported requested and received support during the week, along with their satisfaction with support and affect. Polynomial regression analyses were conducted and response surface graphs plotted.
Results
After controlling for time 1 affect, the effects of (in)congruence between wanted and received support on positive and negative affect were moderated by requested support, and the effects primarily operated via satisfaction with support. The total effects explained 46% and 57% of the variance in positive and negative affect respectively ($p < .05$). When athletes requested low levels of support, and their wanted and received support were congruent, support satisfaction and in turn time 2 positive affect were greater at high wanted and received support than at low levels; support satisfaction and time 2 positive affect decreased as incongruence between wanted and received support increased. When athletes requested high levels of support, and their wanted and received support were congruent, support satisfaction and in turn time 2 positive affect were greater at high wanted and received support than at low levels; however, when wanted and received support were incongruent, support satisfaction and time 2 positive affect were higher in individuals who received more support than they wanted (i.e., overprovision) than those who wanted more support than they received (i.e., underprovision). The results were broadly similar for negative affect.
Discussion
The study is the first to employ moderation and mediation simultaneously in polynomial regression to explore support congruence. The findings suggest that individuals experienced greater support satisfaction and more favourable affect when their wanted and received were congruent. Incongruence was generally associated with unfavourable affect except that overprovision of support (received > wanted) was beneficial when high levels were requested.
Contact:

dfua@essex.ac.uk

THE INFLUENCE OF MUSIC ON REAL-LIFE PHYSICAL ACTIVITY: AN EEG STUDY

BIGLIASSI, M., KARAGEORGHIS, C.I.

BRUNEL UNIVERSITY LONDON

Introduction
Auditory stimuli have been used extensively in physical activity contexts as a means by which to render a given task more pleasurable. Nonetheless, the brain mechanisms that underlie the psychological effects of auditory stimuli during physical activity are hitherto under-researched; particularly so in ecologically valid settings. The objective of the present experiment was to further understanding of the effects of two contrasting auditory stimuli conditions on psychological responses and brain activity during an ecologically valid outdoor walking task.
Methods
With institutional ethical approval, 24 participants (11 women and 13 men; mean age: 23.5 ± 4.3 years) were required to walk 400 metres at a pace of their choosing and report perceptual (attentional focus and perceived exertion) and affective (affective valence and perceived activation) responses immediately after each exercise bout. Three auditory conditions were administered in a randomised and fully counterbalanced order (control [CO], podcast [PO], and music [MU]). The Physical Activity Enjoyment Scale was also administered at the end of each condition in order to assess the degree to which participants enjoyed each bout of physical activity. Electroencephalography was used to examine electrical activity in the brain during the task. The core components of the EEG cables were protected with active-shielding technology, which served to reduce the influence of extraneous factors and body movements on the electrical signal. The compact EEG amplifier was placed in a compatible and ergonomically-designed backpack. Fast Fourier Transform was used to decompose the brain's electrical activity into different brain frequencies. Lower-alpha (8-10 Hz), upper-alpha (10.5-12.5 Hz), sensorimotor rhythm (SMR; 13-15 Hz), and beta (15.5-29.5 Hz) waves were analysed. The power spectra of five brain regions (frontal, frontal-central, central, central-parietal, and parietal) were averaged and compared across conditions.
Results
The results indicated that MU reallocated attentional focus towards environmental sensory cues, induced more positive affective responses, upregulated arousal, and enhanced perceived enjoyment to a greater degree when compared to CO and PO. Moreover, music upregulated beta waves in the frontal and frontal-central regions of the cortex.
Discussion
Rearrangement of beta frequencies in the brain appears to elicit a more positive emotional state where participants are more likely to dissociate from internal sensory signals and focus on task-irrelevant factors. The positive psychophysiological state induced by musical stimuli can be capitalised upon during many physical activities as a means by which to render a given activity more pleasurable.

COGNITIVE IMPAIRMENT IS ACCOMPANIED BY LOWER PHYSICAL ACTIVITY LEVELS AMONG ELDERLY WITH MEMORY COMPLAINTS

STUCKENSCHNEIDER, T.1,2, RUEDIGER, S.1, ABELN, V.1, VOGT, T.3, SCHNEIDER, S.1,2

1 & 3: GERMAN SPORT UNIVERSITY, GERMANY (COLOGNE); 2: UNIVERSITY OF THE SUNSHINE COAST, AUSTRALIA (MAROOCHYDORE)

Introduction
It is forecasted that by 2030 about 74 million people worldwide will be diagnosed with dementia. This will pose a tremendous burden for patients, caregivers and health care systems. Although physical activity is known to affect cognitive ageing positively and to lower the risk of dementia, the relationship between activity levels and cognitive functions among older people with memory complaints is currently not well investigated.
Methods
121 participants aged above 60 with memory complaints took part in this study. General cognitive function was analyzed using the Montreal Cognitive Assessment (MoCA). Moreover, executive function was analyzed using the Trail Making Test A + B (TMT A + B). Furthermore, physical activity levels were evaluated using the self-reported LASA Physical Activity Questionnaire (LAPAQ; average physical activity per day) and an activity tracker (to collect average steps per day), which the participants wore for 7 consecutive days.
Results
On the basis of the results of the MoCA the 121 participants were subdivided into three different groups. Group 1 reached a score between 19-21, Group 2 had a score between 22 – 25, whereas Group 3 had a score of 26 and above on the MoCA. The groups' physical activity levels (LAPAQ, activity tracker) were analyzed using the one-way analysis of variance with the dependent variable MoCA group. The relationship between general cognitive function (MoCA), executive function (indicated by the difference between TMT B and A) and the physical activity levels (LAPAQ, activity tracker) was analyzed with Pearson's correlation.
Results: Group 1 showed significantly lower activity levels than Group 2 and Group 3 – both, for self reported activity ($p < 0.05$) as well as activity measured by the activity tracker ($p < 0.001$). Moreover, a negative correlation between executive function and steps per day ($p < 0.05$; $r = -0.26$) was found.
Discussion
These findings let us assume that physical activity and cognitive function are closely connected, especially executive function. Therefore, future research and public health approaches should focus on a physical, active lifestyle with the aim to lower the risk of memory complaints, such as dementia, in ageing.
Contact
t.stuckenschneider@dshs-koeln.de

Oral presentations

OP-SH03 Sport organisation and politics

SPORTS GOVERNANCE IN METROPOLITAN REGIONS. THEORETICAL AND EMPIRICAL IMPLICATIONS

TROSIEN, G., RATZ, M., THOMPSON, C.
ACCADIS HOCHSCHULE BAD HOMBURG - UNIVERSITY OF APPLIED SCIENCES

Introduction
The reasons why Metropolitan Regions should have been built, have been discussed very often and from different perspectives (e.g. METREX, 2017 for Europe; IKM, 2017 for Germany). In sports context, a broad and intensive discussion about its importance and relevance for the development in Metropolitan Regions in general is missed. The authors have started the discussion about further methodological questions to compare the different governmental systems for sports within metropolitan regions.
Methods
In Germany there are eleven Metropolitan Regions – since February 2017 there are twelve, because Rhein-Ruhr separated into the Metropolitan Regions of Rheinland and of Ruhr. More or less all areas except of sports are generally a topic of interest. But often there is no attention to operate projects – in particular sports projects - which cover the full potential of the Metropolitan Regions. So, all Metropolitan Regions were asked in two ways: Firstly, the authors asked the headquarters of all Metropolitan Regions what they do for sports and how it is organised. Secondly, the sport-specific stakeholders within the Metropolitan Regions were asked how they participate in their own respects.
Results
It was found that the topic sport is on the agendas of most Metropolitan Regions. However, the execution is very different. The most interesting cases are the Metropolitan Regions Stuttgart and Rhein-Neckar. In both Metropolitan Regions there are own governing bodies for sports-specific relations. Others have found working groups where sports are integrated, but not very prominent or important.
Discussion
In the eleven or twelve Metropolitan Regions more discussions about the importance of sports is necessary as well as approaches to measure and compare the sports activities done for the Metropolitan Regions. The authors have discussed three different approaches: rankings, cluster analysis and network analysis. In the perception of the authors those tools can help governing sports activities for Metropolitan Regions. And the discussion about Metropolitan Regions adds and opens also for European Sports Sciences new perspectives in professionalising.
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INDEPENDENCE OF INDEPENDENT SPORTS FEDERATIONS OF TURKEY

ÖZGÜN, A., AZMI, Y.
GAZI UNIVERSITY

Introduction
In this research, it was aimed to analyze the independence levels of Independent Sports Federations of Turkey in practice and theory.
Methods
In this framework, Independent Sports Federations were analyzed within terms of the election process, determination of federation boards, governmental supervision and employee dimensions. Interview technique which is one of the qualitative research methods was used to the collection of research data. The study data was collected with the interview form applied to sixteen federation (8 Olympic and 8 Non-Olympic) presidents. Also, within research, related laws and regulations were examined and evaluated in the framework of the concept of independence.
Results
According to the results obtained from the content analysis applied to the research data; the General Directorate of Sports has an important influence and pressure In the election process and in the determination of the boards, there are important problems in the delegation system of general assembly, the absence of objective criteria in the supervision of federations, General Secretariats, which is appointed by the general directorate of sports cause major problems.
Discussion
As a result, it can be said that independent sports federations are independent only as names. They are connected and dependent on the General Directorate of Sport in almost every direction.

ORGANIZATION DEVELOPMENT THROUGH SPORT PROGRAMS – THE CASE OF THE PROGRAM „BEWEGT ÄLTER WERDEN IN NRW"

DEITERSEN-WIEBER, A.,KLEIN, M.L.
RUHR-UNIVERSITÄT BOCHUM

Introduction

Profound organisational changes are needed to adopt the demografic challenges in a sport system. The sport association Landessportbund in Northrine Westfalia in Germany responded this task by implementing the program „Bewegt Älter werden in NRW". This program is mainly funded by the regional government. It targets the LSB's member organisations and the local sport clubs to develop more and innovative offerings for elderly people and to integrate them as club members, instructors or even as volunteers. The aim of this study was to investigate the implementation of the program on the part of the member organisations and to evaluate effects on organisational structures and processes.
Methods
The evaluation of the program is based on the logical evaluation model (Programmbaum) of Beywl and Niestroj (2009). It focusses the outputs, outcomes and impacts with reference to the goal of the program BÄW. A qualitative und quantitative content analysis of the yearly reports of the program partners from 2013-2015 was executed to analyse the kind of activities the member organisations have initiated in the context of the program. Furthermore, a questionnaire (n=90) provides information about the staff's working conditions in the project and its valuation of the program.
Results
In 2015, 78 member organizations participated in the program, that means, nearly all local sport associations and 25 of 57 associations for the different kinds of sport. So the first target of the LSB to integrate most of ist member organisations in the program was mostly reached. All program partners have implemented a special position to coordinate the program and to execute measures like community action days and workshops. The development of networking of the member organizations is another goal of the program. All member organisations built networks with for example the commune, health organisations, welfare organisations, senior citizens interest groups or retirement homes.
Discussion
Government-funded programs like the BÄW program in Northrhine Westfalia can be very helpful on the way to adress elderly people to be more physical active. Furthermore, relating to the sport associations and clubs, the dynamic of taking part in such a program can accelerate the process to adopt the demographic challenge in the organisation's structure as well as in the offerings for this growing target group.
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THE SPORTS ORGANIZATIONS ROLE TO COUNTER TERRORISM 'A STRATEGIC STUDY OF THE EGYPTIAN SPORTS CLUBS'

ABDELKHALEK, M.
FACULTY OF PHYSICAL EDUCATION, MANSOURA UNIVERSITY, EGYPT.

Introduction
Terrorism is a crime against humanity, represents a threat to the stability and security of nations and their development. The security organizations become confused to struggle against such phenomenon. The sports clubs are one of the most important organizations. In Egypt, there are about 5000 clubs connect directly to the community and should have a role to counter terrorism. This research aims to set a strategy for the Egyptian sports clubs to counter terrorism as a part of their social and patriotic responsibility.
Methods
The descriptive methods were employed. The questionnaire were put in three axes:
1. The status quo of the clubs in counter terrorism.
2. The proposed preventative issues for counter terrorism.
3. The suggested strategic framework (execution mechanism) to put the role of the clubs in counter terrorism into effect.
The research sample was randomly chosen from those who belong to clubs with a number of 642 members classified into 3 groups:
1. Decision makers in clubs (303 members).
2. Beneficiaries of the clubs services or members (207 members).
3. Elite sports field members (132 members).
The data were processed using arithmetic means, SD, Chi2, ANOVA and LSD Test.
Results
The major results are represented in the agreement of the study sample that sports clubs must establish activities, raise social issues and insert organizational bodies for counter terrorism. Also spreading human rights concepts, enhancement of social values in society, adoption of a clear concept of social partnership and social development, and improvement of the skills of youth and fighting unemployment through sports in order to achieve social peace. In addition, the investment in human resources is the best method to counter terrorism by depending on sports modals.
Discussion
Results pointed that counter terrorism is not the responsibility of security organizations alone, but it is a common mission that must be carried out by all the executive bodies of the country. Also linked to the youth issues as they represent the largest sector of the Egyptians and they are always concerned about human rights, building and improving skills. The process of establishing strategies must include analysis of the status quo of the sports clubs and identifying the basic issues to counter terrorism to be able to design strategy that comes from the vision, mission and goals of those clubs.
The researcher recommends that it should be mandatory to design a strategic plan to counter terrorism featured through deciding values and principles and putting the vision, mission and goals of those clubs together with executive activities required to counter terrorism and achieve social peace with a continuous evaluation.

THE DEVELOPMENT OF HIGH PERFORMANCE SPORT THROUGH LEAGUE SYSTEMS IN INDIVIDUAL SPORTS

ZIMMERMANN, T., KLEIN, M.L.
RUHR-UNIVERSITY BOCHUM

Introduction
In Germany, more and more individual sport associations have introduced league systems over the last decades. Club competitions in a league format are rather unusual for individual sports because competitions are usually held individually (Szymanski, 2003). The aim of

this paper is to analyse which league constructs were chosen in order to adjust the league systems to the peculiarities of individual sports, and which enabling effects the specific construction of the league systems should have for the development of high performance sport level in individual sports.
Methods
As leagues for individual sports present a research desideratum within sport management and sport economics literature, an explorative approach was chosen. For data collection first a document analysis was carried out, based on published league statutes and regulations from all 33 existing individual sports leagues in Germany. Second, qualitative problem-centered interviews with league organizers from 15 individual sports (30 interviews in total) were conducted to explore the governance of the leagues in detail. For the data analysis a qualitative and quantitative content analysis was executed.
Results
The basic construction of individual sport leagues is similar to team sport leagues, although other priorities are set, e.g. a shorter competition season or less participation requirement rules. In addition, special characteristics can be observed, e.g. a league design combining elements of the European and North American league system or competitions between professional and non-professional athletes. The league systems enable the athletes to improve their sporting performance by taking part in regular (team) competitions at differentiated performance levels, strengthen the clubs as institutions educating sporting talents and provide opportunities to the clubs and the national sport associations to promote the sport towards athletes, spectators, sponsors and the media.
Discussion
The league systems in individual sports supplement the individual competition system in a beneficial way. They provide the athletes a suitable competition format for transition to or retention of high performance sport level (Sotiriadou et al.'s, 2008) and improve the institutional conditions for high performance sport in special and for the development of the individual sports in general.
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Contact
timo.zimmermann@rub.de

14:00 - 15:30

Oral presentations

OP-PM07 Hypoxia and Altitude

CONSUMPTION OF A HIGH FAT BREAKFAST ATTENUATES THE SUPPRESSION OF APPETITE AND ACYLATED GHRELIN DURING EXERCISE AT 4300M SIMULATED ALTITUDE

MATU, J., DEIGHTON, K., ISPOGLOU, T., SHANNON, O.M., DUCKWORTH, L.
LEEDS BECKETT UNIVERSITY

Introduction
It is well established that acute exposure to very high altitude (>3500 m) is associated with a suppression of appetite, acylated ghrelin and energy intake. Ghrelin is post-translationally modified with a medium chain fatty acid and this acylation is necessary for ghrelin to exert its orexigenic effects. This novel study investigated the effects of a high-fat (HF) breakfast rich in medium chain fatty acids versus a high-carbohydrate (HC) breakfast on appetite, ghrelin constituents and energy intake at 4300 m simulated altitude.
Methods
Twelve healthy males (mean (SD); age 26 (8) years, body mass index 23.9 (2.7) kg·m-2) completed two, 305-minute experimental trials at a simulated altitude of 4300 m (~11.7% O2) in a normobaric chamber. Trials were conducted in a randomised, single blind, counterbalanced fashion. After an overnight fast, participants entered the chamber and rested until receiving breakfast at 1h. Participants consumed either a HF (60% fat, 25% carbohydrate and 15% protein) or an isocaloric HC (60% carbohydrate, 25% fat and 15% protein) breakfast. One hour after breakfast, participants performed a 60-minute treadmill walk at 50% of relative VO2max. An ad-libitum buffet meal was consumed 1.5h after exercise. Composite appetite score as well as acylated and de-acylated ghrelin were measured throughout.
Results
At baseline and during the resting period prior to exercise there were no significant differences in any variables between conditions (all P≥0.137). During exercise, area under the curve (AUC) for composite appetite score was significantly higher following the HF breakfast (39 (12) mm·h-1) compared with the HC breakfast (30 (17) mm·h-1, P=0.036). Similarly, AUC for acylated ghrelin was significantly higher during exercise following the HF breakfast (152 (180) pg·mL-1·h-1) compared with the HC breakfast (101 (106) pg·mL-1·h-1, P=0.048). During the post-exercise period there was no significant difference in composite appetite score (P=0.356) or acylated ghrelin (P=0.229) between conditions. No differences were observed during any time period in de-acylated ghrelin (all P≥0.207). Energy intake at the buffet did not significantly differ between conditions (P=0.384).
Discussion
This study suggests that, in comparison with a HC breakfast, a HF breakfast rich in medium chain fatty acids can attenuate appetite suppression during exercise at 4300 m simulated altitude. However, this did not translate into increased ad-libitum energy intake when food was provided 90 minutes after exercise. It would be beneficial for further research to establish whether a prolonged HF diet can promote a positive energy balance at altitude.
Contact
J.Matu@leedsbeckett.ac.uk

PERFORMANCE CHANGES FOLLOWING LHTH AT 1600 OR 1800 M IN NATIONAL LEVEL RUNNERS

SHARMA, A., SAUNDERS, P., GARVICAN-LEWIS, L., CLARK, B., WELVAERT, M., GORE, C., THOMPSON, K.

AUSTRALIAN INSTITUTE OF SPORT; UNIVERSITY OF CANBERRA

Introduction
The efficacy of Live High Train High (LHTH) at low natural altitudes (1,200 to 1,800 m) is not well established. We aimed to determine the effect of LHTH at 1,600 and 1,800 m on haemoglobin mass (Hbmass), and the time-course of sea-level performance changes following LHTH in national level runners.
Methods
After 3 weeks of lead in training at or near to sea-level, 24 runners (5 females, 19 males; Age = 23 ± 6 years; VO2 max = 68 ± 7 ml.kg.min-1) completed a 3 week intervention of living and training at 1,600 m (ALT1600, n = 8), 1,800 m (ALT1800, n = 9) or near to sea-level (CON, n = 7), followed by 3-10 weeks of sea-level racing. Hbmass was measured via CO rebreathing pre and post intervention. Race performance (800 to 5,000-m time) was measured at sea-level during the lead in period (baseline), and repeatedly during the post-intervention period (101 total races post). Training volume (km) and load (via session RPE) were calculated for each session. Differences between groups were assessed using effect sizes (Hedges'g) expressed with 90 % confidence intervals, and the effects of altitude, training, Hbmass and day post-altitude on performance changes were assessed using a general linear mixed-model.
Results
There were large improvements in race performance within ALT1600 (1.5 ± 0.9%) and ALT1800, (1.6 ± 1.3%) when compared to CON (0.4 ± 1.7%); g = 0.83 (-0.10, 1.66) and 0.81 (-0.09, 1.62) respectively. Season's best performances occurred between 5 and 77 days post-altitude in ALT1600 and ALT1800. No significant effect was found for days post-altitude on performance. A significant effect on performance was observed for training volume increase during the intervention ($F_{1,19} = 10.3$, $p = 0.004$). There were very large increases in training load from lead in to intervention within ALT1600 (48 ± 32%) and ALT1800 (60 ± 31%) compared to CON (14 ± 22%); g = 1.24 (0.24, 2.08) and 1.69 (0.65, 2.55) respectively. Very large increases in Hbmass occurred within ALT1600 (3.7 ± 3.8%) and ALT1800 (4.1 ± 4.4 %) versus CON (-1.2 ± 3.3%); g = 1.35 (0.34, 2.20) and 1.34 (0.36, 2.17).
Discussion
Increased training volume contributed to improvements in performance following altitude or sea-level training, highlighting the value of an intensified training period pre-competition. The larger improvements in performance observed after LHTH may be due the greater overall load of training in hypoxia compared to at sea-level. A wide time frame for peak performances suggests the optimal window to race post-LHTH is individual, and factors other than altitude exposure per se, such as training, may be important.

THE EFFECTS OF CLASSIC ALTITUDE TRAINING ON HEMOGLOBIN MASS IN ELITE ENDURANCE ATHLETES

VIKMOEN, O.1, HALLÉN, J.2

1.NORWEGIAN DEFENCE RESEARCH ESTABLISHMENT, 2.NORWEGIAN SCHOOL OF SPORTS SCIENCES

Introduction
Living and training at 2000-2500 m above sea level for 3-4 weeks can increase total hemoglobin-mass (tHb) (1,2). However, Norwegian endurance athletes often live at lower altitudes and for shorter time periods during altitude training camps. Therefore, the purpose of this study was to investigate whether these training camps give sufficient hypoxic dose to affect tHb and other hematological variables.
Methods
Twenty three (20 males and 3 females) elite endurance athletes (14 cross country skiers, 3 biathletes and 6 speed skaters) that included an altitude training camp as part of their yearly training plan were recruited to an altitude group (AG). Ten elite male cross country skiers that lived and trained at low altitude (below 500 m) where recruited as a control group (CG). In the AG, tHb were measured with the optimized CO-rebreathing technique before and 1-3 days after altitude training camps lasting an average duration of 18.8 ± 2.6 days (range 12-22) and at an average altitude of 1832 ± 144 m (range 1700-2000). Venous blood samples were taken to measure hemoglobin concentration ([Hb]) and hematocrit (Hct) and, in combination with tHb, to calculate changes in blood volume parameters. The same measures were carried out in the CG at approximately the same time points.
Results
In the AG, tHb increased by 3.0 ± 2.5 % ($p < 0.05$), and 20 of the 23 athletes increased their tHb. [Hb] increased by 5.3 ± 3.5 % while Hct increased by 6.5 ± 6.2 % (both $p < 0.05$). Blood volume and plasma volume were reduced by 2.5 ± 3.0 % and 6.7 ± 6.0 % respectively, (both $p < 0.05$) while RCV increased by 3.6 ± 4.9 % ($p < 0.05$). No changes occurred in these variables for the CG.
Discussion
The results from the current study indicate that living at 1800 m natural altitude for 2-3 weeks induces an increase in tHb in elite endurance athletes. This is in accordance with recent studies (3,4), and is important knowledge for elite endurance athletes when longer training camps may be difficult, for instance during the competitive season.
References
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Contact
olav.vikmoen@ffi.no

EFFECT OF HYPOXIA ON WORK ABOVE CRITICAL POWER, MUSCLE ACTIVATION AND FATIGUE DURING INTERMITTENT HIGH-INTENSITY CYCLING

TOWNSEND, N., NICHOLS, D., SKIBA, P., RACINAIS, S., PERIARD, J.

ASPETAR ORTHOPAEDIC AND SPORTS MEDICINE HOSPITAL

Introduction
The work-balance model of intermittent performance (W'BAL model) is derived from the critical power (CP) concept. Recent evidence indicates that work above CP (W') is mechanistically linked to the development of fatigue. The aim of this study was to examine the effect of hypoxia on the relationship between W' remaining (W'BAL), muscle activation, and fatigue, during high-intensity cycling.

Methods
Nine trained, male cyclists (mean ± SD; age 34 ± 6.6 yr, VO2peak 4.57 ± 0.47 L.min-1) completed a series of 3 cycling time trials (TT; 12, 7 and 3 min) to determine CP and W' in normoxia (≈250 m) and hypoxia (≈2250 m). On separate days, an intermittent exercise test (INT) incorporating a series of graded 3-5 sec isokinetic (100 rpm) efforts at baseline, followed by nine intervals concluding with a 3 min TT, was performed in normoxia and hypoxia. During INT, maximal sprints were performed following the 3rd, 6th, 9th interval, and final TT respectively. W'BAL was computed throughout and root mean squared EMG activity of VL, RF and BF muscles determined for each sprint. Performance fatigue (PF), activation fatigue (AF) and muscle fatigue (MF) were calculated for each sprint effort according to the baseline power-EMG relationship and expressed in watts (W). Linear mixed modeling was used to examine the fixed effects of hypoxia and W'BAL on fatigue variables. Results presented as mean slope [95% confidence interval], P value.
Results
W'BAL during INT was strongly associated with PF (-440 [-533 to -347] W; P<0.001), AF (-299 [-400 to -198]; P<0.001), and MF (-145 [-223 to – 68] W; P<0.001). Compared to normoxia, hypoxia exerted a significant effect on PF (-62 [-108 to -15] W; P=0.009), and AF (-63 [-117 to -8] W; P=0.03). There was no significant interaction between hypoxia and W'BAL for any fatigue variable.
Discussion
The results indicate a strong association between W'BAL and fatigue variables during the INT task. Throughout high-intensity exercise, AF exerts a major effect on limiting the ability to produce peak power output, whilst MF appears to exert minimal direct influence until the most severe levels of PF are reached at end exercise. Moderate hypoxia decreases CP, but does not alter the relationship between W'BAL and fatigue.

THE RELATIONSHIP BETWEEN INTER-INDIVIDUAL VARIATION OF SPO2 AND ENDOCRINE RESPONSES UNDER MODERATE HYPOXIC CONDITION

MORI, H., HWANG, H., GOTO, K.
RITSUMEIKAN UNIVERSITY

Introduction
Hypoxic training is known as a procedure for improving endurance capacity. On the other hand, there are large inter-individual variations for performance adaptations following hypoxic training, and some athletes do not reveal performance improvement, which is called as "nonresponder" (Chapman et al., 1998). We have previously reported that arterial O2 saturation (SpO2) showed about 10% inter-individual difference during exercise under hypoxic condition (a simulated altitude of 2500m, Mori et al. 2014). However, the influence of different SpO2 on metabolic and endocrine regulations remains unclear. Therefore, the purpose of the present study was to determine the relationship between inter-individual variation of SpO2 and exercise-induced endocrine responses under moderate hypoxic condition.
Methods
Sixteen healthy men (Age: 22 ± 2 years; Height: 174.6 ± 7.6 cm; Weight: 67.8 ± 8.6 kg) completed two experimental trials on separate days: a 60min cycling at 65% of VO2max followed by 1h of rest period under either normoxic condition (FIO2=20.9%) or hypoxic condition (FIO2=14.5%). Both trials were performed in an environmental chamber. Exercise-induced growth hormone (GH), cortisol, ketone body, lactate (BLa) and glucose responses were determined before exercise, immediately after exercise and 1h after exercise. The SpO2 and heart rate (HR) were measured over time during experimental trial. Based on variation of SpO2 during exercise, twelve subjects were assigned to lower (< mean - 0.25SD) SpO2 group (LOW, n=6) or higher (> mean + 0.25SD) SpO2 group (HIGH, n=6).
Results
SpO2 during exercise session remained significantly higher in HIGH than in LOW under hypoxic condition only (86.6 ± 1.4% vs. 79.8 ± 1.7%). Relative exercise intensity (%VO2max) and HR were not significantly different between LOW and HIGH in either hypoxic or normoxic conditions. BLa, glucose, GH, cortisol and ketone body concentrations were not significantly different between the two groups at any time points.
Discussion
In the present study, the average difference of SpO2 between LOW and HIGH was about 7%, and the difference did not affect significantly exercise-induced GH or cortisol responses. Kurobe et al. (2012) reported that exercise-induced GH response was augmented in severe hypoxia (a simulated altitude of 5,000m) than in sea level and moderate hypoxia (a simulated altitude of 3,000m). However, in the above study, SpO2 during exercise was decreased until about 70% in severe hypoxic condition. Thus, the lack of difference in endocrine responses in the present study may be attributed to be insufficient decrement of SpO2 during exercise. In conclusion, inter-individual variation of SpO2 during exercise in moderate hypoxia did not affect exercise-induced GH or cortisol responses.
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EFFECT OF SWIM INTENSITY ON RESPONSES TO DYNAMIC APNEA

GUIMARD, A., COLLOMP, K., ZORGATI, H., BRULAIRE, S., WOORONS, X., AMIOT, V., PRIEUR, F.
CIAMS UNIVERSITÉ PARIS SUD-UNIVERSITÉ D'ORLÉANS

Introduction
Swimming in complete apnea is currently used in competition to reduce the number of breaths in a sprint or to improve underwater glide. It is also used in training in different distances or intensities since it could improve aerobic and/or anaerobic capacity (Lemaître et al., 2010). However, to date, no study has examined the physiological impacts of swim intensity on acute responses of dynamic apnea (in a 50-m front crawl).
Methods
Nine swimmers performed one 50-m front crawl trial in four different conditions: at 400 m velocity (V400) with normal breathing (NB), at V400 in complete apnea (Ap), at maximal velocity (Vmax) with NB and at Vmax in Ap. Different parameters were measured including 50-m swimming time (t50), peak heart rate (HRpeak), blood lactate concentration after exercise (Lacpost ex) and arterial oxygen saturation (SpO2).
Results

Swimming in Ap induced no significant change in t50, HRpeak and Lapost ex compared with NB. t50, HRpeak and Lapost ex in Ap and in NB were significantly lower at V400 than at Vmax. Swimming in Ap at both different intensities induced no change in the kinetics of SpO2. A large decrease in SpO2 was observed at the end and after the exercise. The minimal value of SpO2 in Ap was reached 10 to 11 s after the end of V400 and Vmax (81.7 ± 3.4% and 84.4 ± 3.5%, respectively).
Discussion
While t50, HRpeak and Lapost ex were lower at V400 than at Vmax in Ap (indicating a lower metabolic intensity at V400), apnea did not result in a lower arterial O2 decrease at submaximal velocity compared to maximal velocity. The higher duration of apnea during submaximal exercise may explain why SpO2 reached the same values as for maximal exercise. Moreover, the decrease in SpO2 began at the end of the 50 m distance and reached its minimal value after about 10 s for both intensities.
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Oral presentations

OP-PM53 Ankle and ACL injuries

CHANGES IN DYNAMIC STABILITY AFTER ACL RECONSTRUCTION AND REHABILITATION

KRAFFT, F.C., RINGHOF, S., STETTER, B., POTTHAST, W., ELLERMANN, A., FLECHTENMACHER, J., EBERLE, C., SELL, S., STEIN, T.
KARLSRUHE INSTITUTE OF TECHNOLOGY (KIT)

Introduction
Concomitant with Anterior Cruciate Ligament (ACL) tears, receptors and sensory pathways inside the ACL get damaged. This supports the process of knee joint deficiency, as an intact sensorimotor system is essential for postural stability (McHugh et al. 2002). Further, postural stability is important for injury prevention, as a more stable body reduces the incidence of lower extremity injuries (Verhagen et al. 2004). The purpose of this study was to examine the postural stability of ACL reconstructed subjects in the dynamic situation of one-legged landing after one leg jumps (OLJs) from pre- to six months post-reconstruction.
Methods
20 subjects (age 32.0 yrs) with unilateral tears of the ACL, who received a uniform reconstruction technique and 20 matched healthy controls were included. The study was designed with four test sessions from pre-reconstruction (T1) up to 6 months post-reconstruction (T4). Subjects had to perform submaximal OLJs for distance onto a 3D force plate (1000Hz). Landing had to be stable with no movement of the landing foot after ground contact. For determination of dynamic stability, dynamic postural stability index (DPSI) was calculated (Wikstrom et al. 2005). Two-way repeated measures ANOVAs were calculated for a sub-group (n=10) who could perform OLJs at T1, T3, and T4. T-tests for independent samples were calculated for comparison of the ACL group with the controls at T4, where all 20 ACL reconstructed subjects could perform OLJs.
Results
DPSIs decreased in the injured (P=0.017) and the uninjured (P=0.009) leg from T3 to T4. DPSIs of the injured and uninjured leg differed significantly at T3 (P=0.017) and at T4 (P=0.013). No differences occurred at T4 between the ACL sub-group (n=10) who could perform OLJs at the three test sessions and the sub-group (n=10) who could not perform OLJs at all test sessions. Compared to the healthy controls no significant differences were found between the injured and non-dominant leg (P=0.167) and the uninjured and dominant leg (P=0.361).
Discussion
DPSIs enhanced in the injured and uninjured leg from 3 to 6 months post-reconstruction. As there were no differences detected between the two ACL sub-groups at T4 we suggest that between three to six months after ACL reconstruction dynamic postural stability recovers, independently if OLJs are performable in advance or not. DPSIs increased to a degree that no differences were detected compared to the healthy controls, showing, that the applied rehabilitation programs enhanced postural stability up to 6 months post-reconstruction. However, because there is a high inter-individual variance we suggest that repetitive comprehensive monitoring of functionality of ACL reconstructed subjects is recommended to detect individual deficiencies and to adapt the rehabilitation program in relation to the subjects' functional deficiencies.
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Contact
frieder.krafft@kit.edu

AUGMENTED FEEDBACK TO REDUCE ACL INJURY RISK IN VOLLEYBALL PLAYERS: A SINGLE BLIND, RANDOMIZED CONTROLLED TRIAL.

BOSSARD, D., HOLDEN, S., COUGHLAN, E., DELAHUNT, E.
UNIVERSITY COLLEGE DUBLIN

Introduction
Volleyball is a sport characterised by a relatively high incidence of ACL injury. Excessive knee joint abduction and increased ground reaction forces upon landing from a jump are associated with an increased risk of sustaining an ACL injury in athletes. Recently, the therapeutic process of augmented feedback has shown promise for improving jump-landing biomechanics. The aim of this study was to determine whether a single augmented feedback intervention could improve jump-landing biomechanics in volleyball players.
Methods
Twenty-eight recreational volleyball players performed six repetitions of a counter-movement jump with a single leg landing (3 x dominant; 3 x non-dominant) pre- and post-intervention. The intervention group (n = 16) received a single augmented feedback intervention, whilst the control group (n=12) received a control intervention. The frontal plane projection angle (FPPA) and maximum knee flexion angle (MKF) were recorded in 2D with commercially available video cameras (50 Hz); knee joint angles were calculated with Dartfish Software.

The peak vertical ground reaction force (vGRF) and time to peak vGRF were recorded on a force platform (1000 Hz) and analysed using Codamotion software. A multivariate analysis of variance was used to analyse the data.
Results
Post-intervention the intervention group displayed significantly greater MKF in the right lower limb (RLL) ($P<0.01$) and the left lower limb (LLL) ($P<0.01$) as well as significant reduction in FPPA in the RLL ($P<0.01$). There was no significant change of FPPA in the LLL. Furthermore, there was a significant reduction in peak vGRF in the RLL ($P<0.01$) and the LLL ($P<0.05$) and a significant increase in time to peak vGRF in the RLL ($P<0.01$). There was no significant change in time to peak vGRF in the LLL.
Discussion
The results of this study suggest that a single, video assisted augmented feedback intervention may improve landing biomechanics in a countermovement jump with single leg landing in volleyball players. The observed improvements in jump-landing biomechanics post-intervention included an increase in MKF, a reduction in FFPA at maximum knee flexion, reduced peak vGRF and increased time to peak vGRF. These collectively may reduce the risk of incurring an ACL injury. Further research related to the retention and transfer of the learned improvements as well as longer intervention periods are needed to support the use of augmented feedback as a therapeutic intervention to decrease ACL injury risk in volleyball players.

DEFICITS IN SUBTALAR FORCE SENSE AND JOINT POSITION SENSE IN SUBJECTS WITH UNSTABLE ANKLES

HAGEN, M.1, LEMKE, M.1, LAHNER, M.2

1 UNIVERSITY DUISBURG-ESSEN, 2 RUHR-UNIVERSITY BOCHUM

Introduction
Deficits in joint position sense (JPS) and force sense (FS) are one functional insufficiency contributing to chronic ankle instability (CAI) (Hertel, 2002). To date, JPS and FS have been only investigated in the sagittal and transverse movement planes, but not in the movement plane defined by the axis of the subtalar joint (STJ). The purpose of this study was to investigate subtalar JPS as well as pronator and supinator FS in supinated and pronated joint position in subjects with CAI. We hypothesised that in subjects with CAI, deficits in JPS sense would appear especially in the supinated joint angles of the subtalar movement plane.
Methods
Subtalar JPS and FS were tested in 20 sport students with CAI and 20 injury-free, age- and sex-matched control subjects. Testing JPS and FS was performed using a force transducer and a goniometer integrated in a specific foot apparatus with a movement axis corresponding to the STJ axis identified by Isman and Inman (1967). JPS and pronator/supinator FS were assessed in STJ angles 8° pronated and 24° supinated position. A MANOVA with the independent factors 'group' and 'angle' following a univariate two-way ANOVA was applied to identify angle-specific differences in JPS and FS.
Results
Compared to uninjured subjects, CAI leads to reduced pronator ($p<0.01$) and supinator FS ($p<0.01$) as well as JPS ($p<0.05$). A significant main effect for 'angle' was found for JPS ($P<0.0001$). JPS is affected by a significant 'group' x 'angle' interaction ($p<0.05$) indicating reduced JPS in the supinated angle 24° but not in the pronated angle 8°.
Discussion
When testing the proprioceptive capabilities in the STJ movement plane, deficits in subtalar JPS and both pronator and supinator FS are present in individuals with CAI. Angle-dependent deficits in the anatomical subtalar JPS have to be considered when assessing proprioception in subjects with CAI and when designing preventive exercise programmes.
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Contact
marco.hagen@uni-due.de

THE EFFECTS OF EARLY PROPRIOCEPTIVE TRAINING ON BALANCE AND REACTION TIME IN ACUTE ANKLE INVERSION TRAUMA

YIGIT, B., BEK, N.

ISTANBUL BILIM UNIVERSITY, HACETTEPE UNIVERSITY

Introduction
Ankle inversion trauma (AIT) induces deficit on proprioceptive mechanism (Beynnon et al., 2006).Proprioception has an important role on balance and reaction time (RT) (Doherty et al., 2015).In the literature, there are many researches investigated the effect of proprioceptive training on balance and RT after chronic ankle instability. The aim of this study was to investigate the effects of early proprioceptive training (EPT) on balance and RT in acute AIT because it is unclear in the literature.
Methods
35 participants were included in 2 groups; physiotherapy group (PG) (n=18) and control group (CG) (n=17). PG received a classical treatment protocol (RICE protocol, ROM without pain, strengthening, manual therapy, balance training, cycling and advanced walking) and EPT together. EPT was started in the first 72 hours after injury for PG and at the end of 2nd week for CG. Single leg (SL) and star excursion balance tests (SEBT) (eye opened and closed) were used for balance and Nelson simple RT test for reaction time. Assessments were done before treatment, in the middle (end of 3th week) and after treatment (end of 6th week).
Results
There was significant recovery on eye opened and closed SL in groups ($p=0.000$) but no significance found between groups ($p>0.005$) at all assessment levels.There was significant improvement on SEBT in groups ($p=0.000$) but no significant improvement found between groups ($p>0.005$) at all assessment levels. There were significant decreases in RT on behalf of PG on the third week and at the end of sixth week ($p=0.002$, $p=0.000$ respectively).
Conclusion
This research showed that reaction time could be notably improved by an EPT after acute AIT. However, not only EPT but also classical treatment protocol has no significant effect on balance after acute trauma, whereas balance could be improved with 4 weeks balance training on chronic ankle instability (Cain et al., 2015).We think that the RT is an important performance parameter among athletes. So the earlier improving of the reaction time can lead to athletes' earlier return to sports (Thain et al., 2015). The balance parameter was im-

proved by both of the treatment methods but the significance of the treatments between groups could not be found and therefore further studies are needed to fully investigation of balance among acute AIT patients.

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SPORT INJURY PREVENTION IN INDIVIDUALS WITH CHRONIC ANKLE INSTABILITY: FASCIAL MANIPULATION VS CONTROL GROUP RANDOMIZED CONTROLLED TRIAL

BRANDOLINI, S., LUGARESI, G., SANTAGATA, A., STECCO, C., MARCHAND, A., STECCO, A.
L'ALMA MATER STUDIORUM - UNIVERSITÀ DI BOLOGNA

Introduction
Chronic ankle instability (CAI) (Attenborough et al., 2005) is one of the most common disorders in athletes with high rates of recurrence following an initial ankle sprain. Sprains are often correlated with recurrent sprains, loss of range of motion (ROM), and deficits in proprioception and postural control. However, there are no international guidelines that define atherapeutic gold standard and only few authors have investigated the importance of soft tissue treatment.
It was the aim of the study to evaluate the effectiveness of Fascial Manipulation (FM) (Stecco et al., 2011) as a preventative measure in semi-professional athletes presenting with CAI and to monitor equilibrium, ROM (Boone et al., 1978) of the ankle and patient symptoms through a questionnaire (Martin et al., 2005).
Study Design: Single-blind randomized controlled trial (PADOVA_08072013).
Setting: Rehabilitation department of a medical center.
Methods
Twentynine male subjects (semi-professional footballers (soccer) with CAI) were recruited, nine were assigned to a baseline group, twenty were randomized into two groups: study and control. The baseline group provided baseline data on health status. The three groups followed a specific training program of twenty workouts over four weeks. The study group underwent an additional three FM treatment sessions.
Main outcome measures: Outcomes of equilibrium, ROM, and symptomatology were measured at baseline, before each treatment, and at follow-up at 1, 3, and 6 months.
Results
Two severe traumas and one mild trauma were reported in the control group during the trial period. The outcomes in the study group showed improvements reaching statistical significance.
Conclusion
FM was effective in improving equilibrium, ROM, and symptomatology in footballers with CAI. FM intervention was found to be effective in preventing injury in the study sample.

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CHRONIC ANKLE INSTABILITY IS ASSOCIATED WITH DEFICITS IN PROXIMAL LOWER LIMB STRENGTH AND BALANCE: A CASE-CONTROL STUDY

KHALAJ, N., VICENZINO, B., SMITH, M.D.
UNIVERSITY OF QUEENSLAND

Introduction
Chronic ankle instability (CAI) is a common consequence of ankle sprains, characterised by repeated sprains, instability and 'giving way' (Anandacoomarasamy et al., 2005; Gribble et al., 2013). Clinical impairments associated with CAI include impaired proprioception, balance, ankle strength and ankle range of motion. Proximal lower limb strength is important in postural control/balance, distal segment control and injury prevention (Niemuth et al., 2005). We propose that reduced proximal limb strength is a feature of CAI and studied hip and knee muscle strength in individuals with CAI compared to controls and individuals with history of one ankle sprain and no ongoing problems (copers). We also investigated the relationship between proximal strength and dynamic balance.
Methods
Isometric strength of the hip and knee was measured using a securely fixated hand-held dynamometer in 58 participants (22 CAI, 22 controls and 14 copers), matched for age, sex, physical activity level, and leg dominance. The Star Excursion Balance Test was used to assess balance in anterior, posterior-lateral (PL), and posterior-medial (PM) directions. Standardised Mean Differences (SMD) and Pearson's Correlation Coefficient are reported herein as point estimates of effect.
Results
There were large SMD (>1.2) strength deficits of all hip and knee muscles in CAI participants compared to controls with the exception of the hip rotators. Flexors and extensors of the hip and knee exhibited moderate deficits (SMD ~1) in participants with CAI compared to copers. Balance was impaired in CAI participants compared to healthy controls and copers in all movement directions. There was a strong positive correlation between abductor strength and PL balance (R=0.526), and moderate correlations between knee strength (R= 0.434) and hip extensor strength (R=0.454) and PL balance.

Discussion
Proximal lower limb weakness is a feature of CAI and is associated with impaired balance. Assessing and managing weak hip and knee muscles might help address impaired balance in CAI.
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Contact
m.smith5@uq.edu.au

Oral presentations

OP-PM09 Performance and recovery

EFFECTS OF POST-EXERCISE SAUNA BATHING ON RECOVERY OF SWIM PERFORMANCE

SCHIMPCHEN, J., SKORSKI, S., MITTENMÜLLER, J., PFEIFFER, M., FERRAUTI, A., KELLMANN, M., MEYER, T.
SAARLAND UNIVERSITY

Introduction
Post-exercise recovery interventions have become a widespread addition to the daily routines of athletes. One common recovery modality that appears to be popular among athletes is sauna bathing. The aim of this study was to investigate whether sauna bathing following an intensive training session can enhance recovery in well-trained swimmers.
Methods
20 well-trained swimmers and triathletes (17.3 ± 2.1 y) participated in the study. Athletes completed an intensive 90 min training session (s-RPE: 593 ± 136 AU) followed by either a sauna bathing intervention (SAU) or a placebo condition (PLA) in randomized order and separated by 7 days. SAU consisted of 3x8 min of sauna bathing at 80-85°C, while during PLA athletes were required to apply a deidentified, pH-balanced massage oil to their body while passively resting in a seated position. Since the placebo effect might partly be responsible for benefits of SAU the athletes were told that this "novel recovery oil" was considered to be effective in terms of performance restoration (Broatch et al., 2014). Prior to training swimmers performed a CMJ test as well as a 4x50-m all out swim test with 30 s of recovery between bouts. Additionally, venous blood samples (analyzed for CK and UREA) were drawn from the athletes and subjective ratings of general fatigue and recovery were collected using a questionnaire (Acute Recovery and Stress Scale) (Hitzschke et al., 2016). All assessments were repeated on the following morning prior to training.
Results
Athletes performed significantly worse during the 4x50-m swimming test after SAU compared to PLA (overall 200-m time: P=0.02; SAU vs CON: + 2.3 s), with the most pronounced decrease in performance occurring over the first 50-m bout (P=0.04; SAU vs CON: + 0.7 s). The performance of half of the athletes deteriorated beyond the day-to-day-variability, while only one athlete improved. CMJ performance (P=0.35) as well as the athletes' perception of overall recovery (P=0.59) and overall stress (P=0.09) were not affected by the intervention. With regard to blood parameters, there were no significant differences for either CK (P=0.39) or UREA (P=0.32).
Conclusions
A single exposure to SAU post-exercise was shown to impair the athletes' sport-specific performance capabilities during the following training session. Based on these results, athletes should be advised to abstain from sauna bathing prior to competition and hard training sessions. However, previous research has demonstrated favorable effects for a long-term use of SAU over 3 weeks with regards to aerobic performance (Scoon et al., 2007). Possibly there is a delayed SAU recovery effect. It appears that the use of SAU needs to be planned carefully to ensure all training benefits can be reached.
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Contact
jan.schimpchen@uni-saarland.de

EFFECT OF PLYOMETRIC TRAINING ON SPRINT PERFORMANCE IN PREADOLESCENT BOYS

TOTTORI, N.1, SUGA, T.1, FUJITA, S.1
RITSUMEIKAN UNIVERSITY

Introduction
Sprint ability is one of the fundamental skills in almost all sports. Therefore, it is important for children to have higher sprint ability. Previous studies have indicated that plyometric training (PLT) is an effective method for improving sprint ability owing to significant correlation between the sprint velocity and the jumping height. However, only few studies (Kotzamanidis 2006, Lloyd et al. 2016) have examined the effect of plyometric training on sprint performance in preadolescent children. The adaptive mechanisms of improving sprint ability by PLT have not been clarified. Therefore, the purpose of this study was to investigate the effect of PLT on sprint performance, which consists of step rate and step length, in boys before the age of peak height velocity.
Methods
Twenty boys participated in this study, and were divided into two groups, a PLT group (n = 9; age, 10.5 ± 0.3 yrs) and a control-training group (n = 11; age, 10.8 ± 0.3 yrs). All participants were found to be before the age of peak height velocity by a regression equation (Mirwald et al. 2002). Both groups performed respective training programs once weekly for 8 weeks. Sprint ability was assessed by 50-m sprint time and sprint velocity, step rate, and step length at 10-m intervals. Jumping performance was tested by horizontal and vertical jumps and rebound jump. Knee extension and flexion torques were collected. The cross-sectional area of quadriceps femoris and hamstrings were measured by magnetic resonance imaging. All tests were conducted at baseline and post intervention.
Results and Discussion

PLT group significantly improved 50-m sprint time and sprint velocity for distances 20-30 m ($P < 0.05$). Additionally, step length and maximal sprint velocity tend to increase ($P < 0.10$). Moreover, rebound jump index ($P < 0.01$) was significantly increased with a trend of decreasing the ground contact time during rebound jumping. There results reveal that PLT contribute to greater stretch shortening cycle and sprint velocity at maximum velocity phase. In addition, both groups showed significant improvements in knee extension/flexion torques and CSA of two muscles ($P < 0.01$), while no significant group differences were observed.
Conclusion
The results of this study suggest that the plyometric training in boys before the age of peak height velocity has positive effects of sprint velocity and step length at maximum velocity phase concomitant with an increased stretch-shortening cycle.
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Contact
sh0037xp@ed.ritsumei.ac.jp

A RETROSPECTIVE ANALYSIS OF ATHLETIC PERFORMANCE DEVELOPMENT IN ELITE JUNIOR TENNIS PLAYERS: A SEVEN YEAR REVIEW

FETT, J., ULBRICHT, A., FERRAUTI, A.

RUHR-UNIVERSITY BOCHUM

Introduction
The modern game of tennis has evolved from being a primarily technique-based sport to an explosive sport, and has thus increasingly become more dynamic and faster. It is presently characterized by strength, speed, and power with higher stroke and serve velocities, that require a notably higher level of physical fitness (Kovacs, 2007). Therefore, the aim of the present investigation was to analyze the long-term development of athletic performance in elite junior tennis players during the last seven years.
Methods
3084 male (m; 13.9±1.9yrs, 166.6±13.4cm, 54.2±13.9kg) and 2074 female (f; 13.8±1.8yrs, 162.7±9.4cm, 52.1±10.4kg) junior squad players, matched into 2yrs age categories, performed the standardized German Physical Condition Tennis Test including hand grip strength (GS), serve velocity (SV), medicine ball throw (MBT) overhead (OH), MBT forehand (FH), push-ups (PU), multiple rebound jumps (RJ), tapping (T), countermovement jumps (CMJ), 20m sprint (S), and tennis-specific endurance (E) (Ulbricht, 2016). Physical testing took place twice a year which results in a total of 14 measurement points. One-factorial ANOVA was used to determine mean differences in athletic performance parameters regarding points of measurement as well as Pearson correlation to quantify the changes of mean physical performance during the last seven years according to age group and sex.
Results
Significant differences ($p<.05$) in athletic performance regarding points of measurement were found for nearly each parameter, with exception of PU. Further, significant moderate to very large correlations were found in GS (mU12-U16 r=.71-.75; fU12-U18 r=.69-.84), S (mU12-U16 r=-.76- -.87; fU12-U18 r=-.61--.77), T (mU12-U18 r=.50-.81; fU12-U16 r=.66-.76), RJ (mU12-U18 r=.43-.89; fU12-U16 r=.53-.70). In MBT and SV negative correlations were found particularly in the older age groups (SV: mU18 r=-.61, fU16 r=-.55; MBT FH: mU16-18 r=-.65--.71, fU14-U16 r= -.72- -.76; MBT OH: mU16-U18 r=-.59- -.79).
Discussion
Results indicate a positive development in strength (GS) and speed-related qualities (S, T, RJ) while in power-related items (SV, MBT) there is no relation or even a negative development especially in older age groups. It can be suspected that in physical training the main emphasis was put on speed related training contents during the last years. However, given the growing importance of the service in the modern tennis game as well as current research which identified the power of the upper extremity to be a main predictor of tennis performance (Ulbricht, 2016), intervention programs focusing on power of the upper extremity are urgent to be implemented in today's physical training and talent identification programs.
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Contact
Janina.fett@rub.de

RECOVERY OF CYCLING GROSS EFFICIENCY AFTER TIME-TRIAL EXERCISE

VAN DE WESTELAKEN, L.

VRIJE UNIVERSITEIT

Introduction
Gross efficiency (GE), one of the performance determining factors in cycling, declines during time trial exercise (1). The decline in GE is dependent on exercise intensity, as a larger decline was observed after shorter time trials. It seems that GE can recover while cycling at a submaximal exercise intensity after the time trial (1). At least 45 min of absolute rest was suggested to counteract for an increased VO2 amplitude (i.e. reduced GE) after heavy exercise (2). However, the time course of the recovery of GE during submaximal exercise performed after a time trial is not yet known. Therefore, the purpose of the current study was to determine the time course of the recovery of GE during submaximal exercise performed after time-trial exercise.
Methods
After performing a maximal incremental exercise test, nineteen male cyclists performed time trials of 2.000 and 20.000 m. GE was determined once during the warm-up (pre) and every 3 min during the 30-min post-measurement (post1-post9), while cycling at a submaximal exercise intensity of 55% of the power output attained at maximal oxygen uptake (PVO2max). The magnitude-based inferences approach was used to assess effects (3) and data is reported as mean ± CV(%).
Results
During the first half of the submaximal exercise bout performed after the 2,000-m time trial, a most likely and very likely increase in GE was seen. No recovery of GE was observed during the second part of the submaximal exercise bout. A total increase in GE from 19.5 ± 5.9 to 20.8 ± 4.8 was observed during the submaximal exercise after the 2,000-m time trial. After the 20,000-m time trial, only a possible

increase in GE was found. In total, a small decline in GE from 21.2 ± 4,5 to 20.9 ± 5.8 was observed after the 20,000-m time trial. At the end of the submaximal exercise bout, still a most likely difference between the post9 GE-value (2 km: 20.8 ± 4.8, 20 km: 20.9 ± 5.8) and the pre GE-value (2 km: 22.0 ± 4.1, 20 km: 22.5 ± 4.0) was seen.
Discussion
GE recovered predominantly during the first 15 min of the submaximal exercise performed after the 2,000-m time trial, but never fully recovered compared to the GE value attained before the time trial. Only possible recovery of GE was found during the submaximal exercise bout after the 20.000-m time trial. Thus, cycling for 30 min at a moderate exercise is insufficient for total recovery of GE. A lower exercise intensity or a longer duration could possibly provide a prolonged recovery period and a larger recovery magnitude.
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Contact
Larsvdwestelaken@hotmail.com

WHOLE- BODY COMPRESSION GARMENTS AND NEUROMUSCULAR ELECTRICAL STIMULATION DO NOT PROMOTE RECOVERY FROM A CROSS-COUNTRY SPRINT SKIING COMPETITION IN ELITE SKIERS

GOVUS, A., ANDERSSON, E.A., SHANNON, O., PROVIS, H., KARLSSON, M., MCGAWLEY, K.

MID SWEDEN UNIVERSITY

Introduction
To investigate whether compression garments (CG) and neuromuscular electrical stimulation (NMES) augment post-race recovery compared with a passive control group (CON) following a cross-country sprint skiing competition.
Methods
Twenty-one senior (12 males, 9 females) and 11 junior (6 males, 5 females) Swedish national team skiers performed a sprint skiing competition involving four, ~3-4 min sprints. After the race, skiers were matched by sex and skiing level (senior versus junior) and randomly assigned to a CON (n = 10), CG (n = 11) or NMES group (n = 11). Creatine kinase (CK) and urea, countermovement jump height (CMJ) and perceived sleep duration, sleep quality and muscle pain were measured before and 8, 20, 44 and 60 h after the race to assess the efficacy of each recovery intervention.
Results
Neither CG nor NMES promoted the recovery of blood biomarkers, perceived wellness nor CMJ post-race compared with the passive control group (all $P < 0.05$). When grouping all 32 participants, CK and muscle pain increased from pre-race values, peaking 20-44 h post-race ($P < 0.05$). CMJ was lower than pre-race values 44 and 60 h post-race in males and females (both $P < 0.05$). Sleep duration increased from pre-race to post-race ($P < 0.05$), whereas sleep quality was unchanged ($P > 0.05$).
Discussion
A cross-country sprint skiing competition induced symptoms of exercise-induced muscle damage peaking 20-44 h post-race. However, CG and NMES did not augment the recovery of physiological, perceptual or performance parameters compared with a passive control group after the sprint skiing competition.

Oral presentations

OP-PM39 Health and fitness in children and adolescents 1

CHILDREN AND ADOLESCENT'S INTERPRETATIONS AND UNDERSTANDING OF 3D PRINTED MODELS OF PHYSICAL ACTIVITY

CROSSLEY, S.G.M.1, MCNARRY, M.A.1, KNOWLES, Z.2, ESLAMBOLCHILAR, P.3, MACKINTOSH, K.A.1

1: APPLIED SPORTS, TECHNOLOGY, EXERCISE AND MEDICINE RESEARCH CENTRE, SWANSEA UNIVERSITY, 2: SCHOOL OF SPORT AND EXERCISE SCIENCE, LJM UNIVERSITY, 3:COMPUTER SCIENCE DEPARTMENT, SWANSEA UNIVERSITY

Introduction
A significant proportion of children in the UK fail to engage in the recommended 60 minutes of moderate-to-vigorous physical activity (MVPA) every day. One of the major barriers encountered in achieving these physical activity (PA) targets is the perceived difficulty for children to interpret and apply these in terms of their everyday activities. Advances in 3D printing have enabled novel ways of representing PA levels through personalised tangible 3D models. The purpose of this research was to elicit children and adolescent's interpretations and understanding of age-specific 3D PA models.
Methods
Twelve primary school children (9 boys, 7.8+/-0.4 years) and 12 secondary school adolescents (6 boys, 14.0+/-0.2 years) participated in semi-structured individual interviews. Interview questions were structured around PA levels and intensities, the use of accelerometry to measure PA, the 3D printing process, and their ability to interpret 3D models of PA. Understanding of these intensities and 3D models was further assessed through two interactive tasks matching different types of PA to levels of intensity, and a 3D model recall test. All interviews were transcribed verbatim, content analysed and outcomes were represented as diagrammatic Pen Profiles.
Results
Both children and adolescents demonstrated the ability to accurately interpret different components of the 3D models, were able to compare and distinguish between different 3D models of PA and showed understanding of the importance of enhancing PA levels. However, primary school children demonstrated more difficulty in differentiating between the intensities of PA represented on the 3D models. Nonetheless, the target bar enabled both children and adolescents to understand government guidelines associated with the role of PA in achieving a healthy lifestyle.
Discussion
The study suggests that 3D models of PA can be an innovative educational tool to provide a more personalised and meaningful way of interpreting government PA guidelines. Furthermore, this novel method of feedback has shown potential for influencing behavioural

change in UK children and adolescents by rewarding them with tangible outputs that generate increased awareness and understanding of the importance of a physically active lifestyle.

ADIPOSITY, MUSCULAR FITNESS AND CARDIOVASCULAR RISK FACTORS IN ADOLESCENTS: DEFINING ROLES THROUGH MEDIATION ANALYSIS.

PÉREZ-PÉREZ, A.1, SEGURA-JIMÉNEZ, V.1, FERNÁNDEZ-SANTOS, J.R.1, CABANAS-SÁNCHEZ, V.2, GÓMEZ-MARTÍNEZ, S.3, VEIGA, O.L.2, MARCOS, A.3, CASTRO-PIÑERO, J.1

1: UNIVERSITY OF CADIZ (CADIZ, SPAIN), 2: AUTONOMOUS UNIVERSITY OF MADRID (MADRID, SPAIN), 3: ICTAN-SPANISH NATIONAL RESEARCH COUNCIL (MADRID, SPAIN).

Introduction
Muscular fitness and adiposity are associated with cardiovascular disease (CVD) risk factors in youth. However, the extent to which muscular fitness exerts a direct effect on CVD risk or whether adiposity leads the influence of muscular fitness in this association in adolescents has not been clearly defined. We aimed: (1) to test the individual and combined effect of muscular fitness and body mass index (BMI) on clustered CVD risk factors in adolescents, and (2) to examine if the association between muscular fitness and clustered CVD risk factors is mediated by BMI.
Methods
A total of 258 adolescents (119 girls) aged 12-17.9 years participated. Height and weight were measured and BMI was calculated. Muscular fitness was assessed with handgrip/weight and standing long jump tests. These tests were combined in a global muscular fitness score. A CVD risk score was computed from the mean of the standardized values of waist circumference, systolic blood pressure, triglycerides, high-density lipoprotein cholesterol and glucose. Mediation analyses were performed according to Baron and Kenny procedures.
Results
Handgrip/weight ratio and the muscular fitness score were associated with CVD risk score only in boys, but this association disappeared after adjusting for BMI. The association between BMI and CVD risk score was independent of muscular fitness in both sexes (all $p < 0.001$). In general, according to combined analyses, those adolescents who presented a favourable weight status showed lower CVD risk scores than their overweight/obese counterparts, regardless of muscular fitness levels (all $p < 0.05$). Mediation analyses showed that the association between muscular fitness and CVD risk score was completely mediated by BMI in boys ($z = -5.493$, $p < 0.001$). No mediating effect was seen in girls since there were no associations between muscular fitness and CVD risk score.
Discussion
A previous study observed using mediation analyses that the association between muscular fitness and cardiovascular risk in children is mediated by BMI (Díez-Fernández et al., 2015), yet there is no studies analyzing this role of BMI in adolescents. In the present study body mass index proved to be an independent predictor of CVD risk in adolescents. In contrast, muscular fitness exerts an indirect effect on CVD risk with BMI mediating this association, only in boys. Exercise programmes aimed at improving CVD risk profile in adolescents should be focused on the achievement of an optimal weight status.
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Contact
alejandro.perezperez@uca.es

CARDIORESPIRATORY FITNESS CUT POINTS FOR EARLY DETECTION OF CARDIOVASCULAR RISK IN CHILDREN: A FOLLOW-UP STUDY

CASTRO-PIÑERO, J.1, PEREZ-PEREZ, A.1, SEGURA-JIMÉNEZ, V.1, APARICIO, V.A.2, GÓMEZ-MARTÍNEZ, S.3, IZQUIERDO-GOMEZ, R.4, MARCOS, S.3, RUIZ, J.R.2

1: UNIVERSITY OF CADIZ (CADIZ, SPAIN), 2: UNIVERSITY OF GRANADA (GRANADA, SPAIN), 3: SPANISH NATIONAL RESEARCH COUNCIL (MADRID, SPAIN), 4: UNIVERSIDAD CENTRAL DE CHILE (SANTIAGO, CHILE)

Introduction
Early detection and diagnosis of cardiovascular disease (CVD) risk factors in children contributes to the development of effective prevention programs, counselling and public health policies in decreasing CVD risk in later life. We (1) studied the association between cardiorespiratory fitness at baseline and CVD risk two years later (follow-up); (2) determined cardiorespiratory fitness cut point associated with CVD risk (cross-sectional); (3) analysed whether the health-related cardiorespiratory fitness cut points identified are associated with CVD risk two years later, and (4) whether changes in cardiorespiratory fitness are associated with CVD two years later.
Methods
213 schoolchildren (98 girls) with complete data at baseline (6-10 years) and 2-year follow-up (8-12 years) were included in the study (9.7% drop out). The 20-m shuttle run test was used to estimate cardiorespiratory fitness. A CVD risk score was computed (sum of two skinfolds, systolic blood pressure, insulin and glucose, triglycerides and total cholesterol/high density lipoprotein cholesterol).
Results
Cardiorespiratory fitness at baseline was inversely associated with single CVD risk factors and CVD risk score at baseline and follow-up (all $P<0.05$ and $P<0.001$, respectively). A cardiorespiratory fitness cut points of ≥39.0 ml/kg/min in boys and ≥37.5 ml/kg/min in girls were found to be discriminative to identify CVD risk in childhood ($P<0.001$, area under the curve >0.85 in both boys and girls). Furthermore, these cut points predicted CVD risk two years later ($P=0.004$). Persistent low cardiorespiratory fitness or the decline of cardiorespiratory fitness was associated with CVD risk two years later ($P<0.001$).
Discussion
A recent meta-analysis provided pooled health-related cardiorespiratory fitness cut points in youth that could serve as standards for international comparisons (Ruiz et al., 2016) yet it was highlighted a lack of studies conducted in children under 10 years. In this follow-up study we provided cardiorespiratory fitness cut points in 6-10-year old children, which are associated with a reduced CVD risk at the baseline and two years later. Cardiorespiratory fitness should be included in monitoring system in order to identify children with poor cardiovascular health; and public health as well as school-based strategies and intervention programs, are required to increase physical activity levels in order to meet health-related cardiorespiratory fitness levels.
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ACUTE EFFECTS OF EXERCISE ON NEUROPHYSIOLOGICAL INDICES OF INHIBITORY CONTROL IN CHILDREN WITH ADHD

LUDYGA, S., GERBER, M., BRAND, S., PÜHSE, U.

UNIVERSITY OF BASEL

Introduction
Children with Attention Deficit/Hyperactivity Disorder (ADHD) show deficits in executive functions, which are most pronounced for inhibitory control (Willcutt et al., 2005). The current evidence suggests that a single aerobic exercise session of moderate intensity has a beneficial effect on executive function (Drollette et al., 2014), whereas the impact of coordinative exercise on inhibitory control has not yet been investigated in children with ADHD. Therefore, the present study aimed to examine the acute effects of moderate aerobic and coordinative exercise on neurophysiological indices of inhibitory control in children with ADHD.
Methods
Using a cross-over design, children with ADHD and healthy controls completed a modified Flanker task before and after 20 min moderate cycling exercise, coordinative exercise and an inactive control condition. During the task, electroencephalography was used to assess stimulus-locked event-related potentials. Adaptive mean amplitude and 70% peak latency of the P300 component were examined as neurophysiological indices of cognitive control.
Results
The effect of exercise on inhibitory control was influenced by exercise modality and group, $F(2,30)=3.6$, $p=.038$. Children with ADHD showed a greater increase of P300 amplitude, $F(1,15)\geq7.7$, $p\leq.014$, and decrease of reaction time after aerobic exercise compared to the other conditions, $F(1,15)\geq6.0$, $p\leq.027$. In healthy children, both aerobic and coordinative exercise elicited a greater increase of the P300 amplitude, $F(1,16)\geq7.8$, $p\leq.013$, and shortening of the reaction time than the inactive control condition, $F(1,16)\geq6.0$, $p\leq.028$.
Discussion
The present findings suggest that coordinative and aerobic exercise selectively benefit inhibitory control in children with ADHD and healthy controls. In this respect, a single aerobic exercise bout seems to be more efficient than coordinative exercise in reducing the inhibitory control deficits that persist in children with ADHD (Willcutt et al., 2005). In line with previous findings, the exercise-induced decrease of the reaction time on the Flanker task went along with an increase of P300 amplitude (Drollette et al. 2014), reflecting increased allocation of attentional resources towards the task. Consequently, benefits of aerobic exercise are due to a decrease of task-related hypoarousal in children with ADHD.
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Contact
Sebastian.ludyga@unibas.ch

CHILDREN WITH MODERATE TO SEVERE INTELLECTUAL DISABILITY HAVE LOW PHYSICAL FITNESS LEVELS.

WOUTERS, M., EVENHUIS, H.M., HILGENKAMP, T.I.M.

ERASMUS MC

Introduction
Children with intellectual disabilities (ID) are more vulnerable for health problems than typically developing (TD) peers. Physical fitness is an important indicator for health. Therefore we investigated the physical fitness of children with moderate to severe ID.
Methods
Field-based physical fitness tests were selected based on literature review and a focus group. One hundred and thirty one Dutch children with moderate to severe ID (83 male; age 9.5 ± 4.1 yrs) performed the following tests: body weight, height, waist circumference, overarm throwing, stairs climbing and the modified six minute walk test. Scores were compared to reference values of TD children. A multiple logistic regression analysis was used to study the association between the score on the physical fitness tests and child characteristics (e.g. sex, chronological age).
Results
High rates of overweight (25%) and obesity (15%) were found in our sample. Moreover, 71-91% of the participants performed below the 5th or 10th percentile of the reference values of TD children. Being female, having younger chronological age and adaptive age and a non-Dutch origin were found to be associated with lower scores on the fitness tests. Regression models explained 46-67% of the variance.
Conclusion
Children with moderate to severe ID have strikingly low physical fitness levels. Priority should be given in policy and practice to increase the physical fitness of this vulnerable population.

Oral presentations

OP-BN04 Neurophysiology

RATE OF TORQUE DEVELOPMENT IS ASSOCIATED WITH MUSCLE FIBER CONDUCTION VELOCITY IN POWER ATHLETES

DEL VECCHIO, A.1, NEGRO, F.2, FALLA, D.3, BAZZUCCHI, I.1, FARINA, D.4, FELICI, F.1

1:UNIVERSITY OF ROME FORO ITALICO,ITALY; 2:UNIVERSITY OF BRESCIA,ITALY; 3:UNIVERSITY OF BIRMINGHAM,UK;4:IMPERIAL COLLEGE,LONDON,UK

Introduction

Power athletes develop greater levels of force in a shorter amount of time compared to untrained individuals. These differences are at least partly of neural origin and can be explained by a training-induced adaptation in the neural drive to muscles (Aagaard et al., 2002; Tillin et al., 2010). This study tested the hypothesis that the generation of explosive force in power athletes is associated with an earlier recruitment of high threshold motor units with respect to untrained individuals.
Methods
Motor unit recruitment was assessed by estimates of the average conduction velocity of motor unit action potentials (Andreassen & Arendt-Nielsen, 1987; Farina et al., 2001) (muscle fiber conduction velocity, MFCV) during a series of isometric explosive force contractions of the elbow flexors in eight power athletes and eight untrained individuals. High-density electromyogram signals (HDEMG, 128 electrodes) were analyzed during four 50-ms intervals starting from the torque and HDEMG onset. Explosive torque, rate of torque development (RTD) and MFCV were computed and normalized to the maximal value obtained during MVC. MFCV was also computed during the electromechanical delay (EMD).
Results
Power athletes were significantly stronger compared to the untrained individuals (99.6 ± 21.6 vs 60.5 ± 8.7, N·m, $p<0.001$). Explosive torque and MFCV values were greater for the athletes during all the time intervals analyzed (mean MFCV, 4.77 ± 0.16 vs 4.13 ± 0.19 m/s, $p<0.001$). However, absolute and normalized RTD were also greater for the athletes but only during the time interval 0-50 ms ($p<0.001$). Interestingly, at the motor unit level, the normalized MFCV was 13% ± 3% greater for the athletes but only during the early phase of explosive force generation (EMD and 0-50 ms). Moreover, a significant correlation between MFCV and RFD measured during 0-50 ms was found in the athletes and the untrained individuals ($R2 = 0.87$, $p<0.001$).
Discussion
These results indicate that power athletes have specific neuromuscular adaptations in the early phase of explosive force that results in a faster recruitment of high threshold motor units (Andreassen & Arendt-Nielsen, 1987). Moreover, the strong association between MFCV and early RTD indicates that MFCV estimates during explosive force contractions may open new perspectives for the evaluation of neuromuscular function in health, training, and pathology.
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Contact
a.delvecchio2@studenti.uniroma4.it

NEURAL CORRELATES OF EXPERT VISUOMOTOR PERFORMANCE AS REVEALED BY VISUAL EVOKED POTENTIALS

HÜLSDÜNKER, T.1, STRÜDER, H.K.1, MIERAU, A.1,2

1. GERMAN SPORT UNIVERSITY COLOGNE, COLOGNE, GERMANY 2. LUNEX INTERNATIONAL UNIVERSITY OF HEALTH, EXERCISE & SPORTS, DIFFERDANGE, LUXEMBOURG

Introduction
Visuomotor reaction time (VMRT) is a key determinant for performance in fast ball sports, and fast ball sports athletes outperform non-athletes in simple visuomotor reaction tasks. However, the percepto-motor mechanisms underlying superior VMRT in athletes remain largely unknown. This has serious limitations for athletes and coaches aiming to set individual training parameters to improve VMRT. Therefore, this series of experiments aimed to identify the neural perceptual and motor-related correlates of VMRT in athletes and non-athletes.
Methods
36 elite badminton players and 28 age-matched non-athletic controls participated in the study. A 64-channel EEG-system was used to investigate pattern-reversal and motion onset visual evoked potentials (VEP) indicating the speed of visual perception in the cortex. For both, contrast and motion stimuli, visuomotor reaction tasks were performed to determine visuomotor transformation in pre- and supplementary motor regions (Brodmann area 6 [BA6]) and the primary motor cortex (BA4). In addition, the latency of the M. flexor carpi radialis activation onset as well as visuomotor performance were identified using electromyography (EMG) and a button press, respectively. Stimulus- and response-locked event-related potentials were calculated to identify perceptual and motor-related cortical processes.
Results
Athletes exhibited an earlier EMG onset and a faster VMRT in response to both contrast (EMG onset: $p=0.015$; VMRT: $p<0.001$) and motion (EMG onset/VMRT: $p<0.001$) visual cues. This was accompanied by a faster visuomotor transformation as reflected by an earlier activation of BA6 in both conditions (contrast: $p=0.015$ motion: $p=0.009$). The athletes' visual perception was faster only for motion ($p=0.002$) but not contrast visual stimuli ($p=0.6$). Neural variables predicted visuomotor performance in response to contrast and motion stimuli across subjects (contrast: $r=0.41$, $p<0.001$; motion: $r=0.83$, $p<0.001$) as well as within the athletes' group (contrast: $r=0.43$, $p=0.03$; motion: $r=0.8$, $p<0.001$).
Discussion
The results indicate selective adaptations in the athletes' visual system according to the visual demands of badminton where athletes have to react to motion rather than contrast visual cues. This is in line with the two distinct neural visual streams subserving contrast and motion perception. In contrast, the faster visuomotor transformation irrespective of the stimulus type argues for a common visuomotor network integrating multimodal visual information. Both, visual perception and visuomotor transformation time were related to VMRT. It is concluded that VEP analysis is an important tool to assess individual differences in visual perception and visuomotor transformation in fast ball sports such as badminton, and it is therefore, of great value for athletes and coaches aiming to set individual training parameters to improve VMRT.

MOTOR IMAGERY COMBINED WITH SENSORY ELECTRICAL STIMULATION INDUCES SPECIFIC SPINAL AND CORTICO-SPINAL MODULATIONS

TRAVERSE, E., LEBON, F., MARTIN, A.

INSERM CAPS, UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ

Introduction

Motor imagery (MI) is the mental simulation of movement, without muscular activity. Recently, studies demonstrated that the combination of MI with sensory stimulation (SS), increased corticospinal excitability (CSE) compared to MI or SS alone (Saito et al. 2013). Yet the effects on spinal mechanisms are unknown while MI and SS have an impact at spinal level (Grosprêtre et al. 2015). The aim of this experiment was to examine the modulations induced by a MI task combined with SS on spinal and CSE.

Methods

Twelve subjects performed three conditions (four blocks of 45seconds duration) twice: 1) MI of a submaximal isometric plantar flexion, 2) SS applied at the popliteal fossa (65 Hz, 1ms pulse width, 9 seconds duration, at an intensity of 80% of motor threshold) and 3) MI+SS for 9 seconds duration. Transcranial magnetic stimulation (TMS) or peripheral tibial nerve stimulation (PNS) were applied before (PRE) and during the interventions to evoke motor evoked potential (MEP) or H-reflex, respectively. Peak to peak amplitude of MEP responses or H-reflex were analyzed for both soleus (SOL) and medial gastrocnemius (MG) muscles. All results were expressed as a function of PRE values.

Results

H-reflex amplitude tended to increase during MI ($p<0.1$) whereas it was significantly depressed when SS was applied (SS and MI+SS conditions). MEP amplitude increased during MI and MI+SS but not during SS. During MI+SS, MEP amplitude was greater than MI for MG only.

Discussion

Spinal excitability is depressed during SS, with or without MI. This is possibly due to presynaptic homosynaptic post activation depression (HPAD) and to refractory period of Ia-afferents, despite the fact that MI tends to reduce this effect (Grosprêtre et al. 2015). CSE increased during MI with no significant effect when SS was applied. In fact, CSE was not modulated by SS. For SOL, MEP amplitude was not decreased during MI+SS compared to MI, despite that spinal excitability was reduced. For MG, CSE was greater during MI+SS compared to MI (Kaneko et al. 2014; Mrachacz-Kersting et al. 2012; Saito et al. 2013). It can be concluded that MI performed during SS can compensate the spinal excitability decrease induced by SS, by modulating the level of presynaptic inhibition acting at the Ia-afferent-alpha motoneuron transmission.

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Contact

elodie.traverse@u-bourgogne.fr

EFFECTS OF 1-HOUR ACHILLES TENDON VIBRATION ON POSTURAL CONTROL IN YOUNG AND OLDER ADULTS

PENZER, F., DUCHATEAU, J., BAUDRY, S.

UNIVERSITÉ LIBRE DE BRUXELLES

Introduction

While maintaining upright standing relies largely on proprioceptive information (Fitzgerald and McCloskey 1994), ageing is accompanied by a decreased contribution of muscle spindle pathway in the synaptic input received by spinal motor neurones when standing upright (Baudry 2016). Further insights on this age-related effect can be obtained by using Achilles tendon vibration (ATV) that modifies the spinal inputs from muscle spindles pathway. For example, prolonged bilateral ATV induced specific depression of the amplitude of the Hoffman (H) reflex during upright compared with sitting posture in young adults (Lapole et al. 2012). In this latter study, however, the consequences of ATV on postural balance were not studied. We therefore assessed postural balance, H-reflex and corticospinal excitability during upright standing before and after prolonged bilateral ATV in young and older adults. Corticospinal excitability was tested to document a possible shift to feedforward control of ankle plantar flexor muscles after ATV.

Methods

Fourteen young (22.9±1.6 yr) and ten older adults (70.1±7.6 yr) stood upright on a force platform before and after 1 hour of bilateral ATV (1-mm amplitude, 80Hz). The mean position (CoPmean) and standard deviation in the backward-forward directions (CoPsd) of the centre of pressure as well as spinal (H reflex) and corticospinal excitability [motor evoked potential (MEP) induced by transcranial magnetic stimulation] were measured before and after ATV.

Results

ATV induced a frontward shift of CoPmean in both groups (+38%, $p<0.05$) whereas CoPsd increased only in young adults (+34%, $p<0.05$). After ATV, the H-reflex amplitude decreased less in older (-23.8%) than young adults (-54.7%) whereas MEP amplitude increased similarly in both groups (+27.4%, $p<0.05$).

Discussion

The frontward shift of CoPmean likely reflects the decrease in synaptic inputs from muscle spindle pathway (Seizova-Cajic et al. 2007) that might be compensated by an increase in descending drive, as suggested by the increased MEP amplitude. However, the lack of change in CoPsd in older adults after ATV suggests a lesser dependence on proprioceptive signal to control balance steadiness for this group (Baudry 2016) that can be reflected in the lesser decrease in H-reflex amplitude in older adults. Overall, this study supports a decreased reliance on muscle spindle inputs to control the soleus activity when standing in older adults.

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Contact: fpenzer@ulb.ac.be

MODULATION OF THE SOLEUS H REFLEX WHEN ASCENDING AND DESCENDING A STAIRCASE IN YOUNG AND OLDER ADULTS

JOHANNSSON, J., DUCHATEAU, J., BAUDRY, S.
UNIVERSITÉ LIBRE DE BRUXELLES

Introduction
The modulation of the Hoffman (H) reflex in soleus (SOL) during the gait cycle highlights the need to adjust the synaptic efficacy between Ia afferents and spinal motoneurones depending on the gait phases (Capaday and Stein, 1986). Such modulation should be even more pronounced during staircase ascent and descent that involve greater knee and ankle moments compared to level walking, especially in older adults (Jacobs 2016). This study investigated the H-reflex modulation when young and older adults ascend and descend a 3-step staircase.
Methods
The H reflex in SOL was recorded in response to tibial nerve stimulation in 19 young (24.4±2.3 yr) and 16 elderly (69.5±5.5 yr) adults, while background electromyogram (EMG) was recorded from SOL, gastrocnemius medialis and tibialis anterior. The stimulus intensity was adjusted to keep constant the amplitude of the M wave that preceded the H reflex across the stride cycle. H reflex and preceding M wave were expressed as a percentage of the maximal amplitude of the M wave (Mmax). The stride cycle during staircase ascent and descent consisted of a stance and a swing phase.
Results
During staircase ascent, H-reflex amplitude increased from 14.4% Mmax at the beginning of the stance phase (two-leg stance part) to 29.1% Mmax in the middle of the phase. The H-reflex amplitude then decreased to 16.2% Mmax at the end of the stance phase, to be only 4.1% Mmax during the swing phase. During staircase descent, H-reflex amplitude was maximal at the beginning of the stance phase (21.0% Mmax) to decrease thereafter to 5.7% Mmax at the end of the stance phase and to rise again at 13.1% Mmax during the swing phase. No difference between age groups was observed in the extent of the H reflex modulation during staircase ascent ($p=0.65$) and descent ($p=0.15$). However, older adults exhibited greater EMG activity for all three muscles in the stance and swing phases compared to young adults in both staircase ascent ($p<0.05$) and descent ($p<0.01$).
Discussion
This study is the first to report the modulation of the soleus H reflex during staircase ascent and descent in healthy young and older adults. Despite smaller H-reflex amplitude in older adults, the H-reflex modulation appears to be similar in both age groups, suggesting that healthy ageing does not influence H-reflex modulation during staircase negotiation. The modulation of the H reflex observed in this study may originate from pre- and/or post-synaptic mechanisms (Zehr 2002).
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Contact
jjohanns@ulb.ac.be

ACUTE EFFECTS OF MOTOR IMAGERY ON SPINAL FACILITATION AND INHIBITION

GROSPRETRE, S., LEBON, F., PAPAXANTHIS, C., MARTIN, A.
C3S - EA4660 ; CAPS - INSERM U1093

Introduction
Motor imagery (MI) is the mental representation of actual contraction without motor output. Training by MI was shown to be a reliable tool to enhance motor performances, and this beneficial effect is classically attributed to the activation of specific brain regions (mostly motor areas). However, it was recently shown that during MI specific spinal networks can also be activated, raising the fact that MI generates a subliminal cortical output that modulates low threshold presynaptic spinal structures (Grosprêtre et al., 2016). The aim of the present study is to examine the acute effect of one session of MI training on spinal network by analyzing the balance between facilitatory and inhibitory processes acting at the level of the Ia afferent-Mna transmission.
Methods
9 healthy young participants took part in the present experiments. H-reflexes and M-waves of the soleus muscle (SOL) were elicited at rest by electrical stimulations of the posterior tibial nerve (Htest). The presynaptic inhibition was assess by conditioning the H-test by a prior stimulation of the common peroneal (ISI 21ms). This conditioning is shown to induce D1 presynatic inhibition of SOL Ia afferences onto alpha motoneurons. Since SOL motoneurons receive facilitatory projections of quadriceps Ia afferents, spinal facilitation was assessed by conditioning SOL Htest by prior femoral nerve stimulation. All participant underwent a MI session of 20 minutes consisting of 4 series of 25 imagined maximal isometric plantar flexion. The following variables were assessed before, at the end the MI session and 10 min after the session: background EMG activity, Mmax, Htest/Mmax, inhibition (-% Htest) and facilitation (+% Htest).
Results
Firstly, no effect of MI before or after the session was observed on background EMG, Mmax and on Htest/Mmax ($p> 0.2$). The initial presynaptic inhibition observed was of - 22.6 % and the facilitation + 8 %. After the MI session, the facilitation was significantly greater than before the session (+ 41 %, $p=0.017$). Spinal inhibition was totally cancelled after the session ($p=0.003$). After 10 minutes recovery, facilitation slightly decreased (+ 22%) and inhibition was still cancelled (- 1%), both different from baseline measurements ($p=0.02$).
Discussion
The present study emphasized the strong facilitatory effect of MI on spinal network, by modulating the excitability of spinal interneurons mediating inhibitory processes. One single session of MI seems sufficient to induce significant changes at spinal level that last until 10 min after the session, raising the involvement of spinal structures on MI-induced neural plasticity.
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Contact
sidney.grospretre@univ-fcomte.fr

Oral presentations

OP-BN07 Biomechanics: Soccer

RELATIONSHIP BETWEEN MUSCLE SIZE OF PSOAS MAJOR AND KICKED BALL SPEED IN SOCCER PLAYERS.

WAKAHARA, T., CHIBA, M.
DOSHISHA UNIVERSITY

Introduction
It is important for soccer players to be able to produce fast ball speed with side-foot and instep kicks, because the fast speed gives defenders less time to react. Previous studies reported that the ball speed of instep kick was significantly correlated with muscular strength of hip flexion and knee extension (Narici et al. 1988). However, less information is available for the determinant of ball speed of side-foot kick. Nunome et al. (2002) showed that the magnitude of hip flexion torque was the largest among the hip, knee and ankle joints in side-foot kick as well as instep kick, suggesting important roles of the hip flexor muscles for developing high ball speed. The purpose of this study was to examine the relationship between muscle size of the hip flexor, the psoas major, and the ball speed of side-foot and instep kicks.
Methods
Twenty-nine male collegiate soccer players participated in the present study. Magnetic resonance images of their lower trunk were recorded to measure the anatomical cross-sectional area (ACSA) of the psoas major of the kicking leg. They performed the maximal instep and side-foot kicks to a stationary ball with a single step approach. The speed of kicked ball was measured with a high-speed camera (480 Hz).
Results
The body height was significantly correlated with the ball speed of the side-foot ($P < 0.001$) and instep ($P < 0.001$) kicks, respectively. After adjustment for body height with semipartial correlation analysis, the maximal ACSA of the psoas major was significantly correlated with the ball speed of side-foot kick ($P = 0.017$), but not with the ball speed of instep kick ($P = 0.144$).
Discussion
The present results indicated that, for a given body height, the size of the psoas major is a significant determinant of the ball speed of side-foot kick. It was reported that the torque and angular velocity of hip external rotation were significantly greater in side-foot kick than in instep kick (Nunome et al. 2002). The psoas major is an external rotator as well as a flexor of the hip joint (Juker et al. 1998). This may be a reason for the significant semipartial correlation between ACSA of the psoas major and ball speed of side-foot kick. The present results suggest that a large psoas major contributes to production of fast ball speed of side-foot kick. Therefore, resistance training aiming at hypertrophy of the psoas major is advisable for soccer players who want to increase ball speed of side-foot kick.
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Contact
twakahar@mail.doshisha.ac.jp

CAN FOOTBALL GOALKEEPERS DIVE FASTER?

IBRAHIM, R., DE BOODE, V.A., KINGMA, I., FABER, G.S., VAN DIEEN, J.H.
VRIJE UNIVERSITEIT AMSTERDAM

Introduction
Similar to many other athletes preparing for an explosive movement, a football goalkeeper (GK) prepares to dive for the ball in a so-called power position, which is assumed to allow optimal development of torques in response to a stimulus. However, it is unclear whether self-selected stance width in that power position is indeed optimal. Therefore, the aim of this study was to vary the stance width in the starting position and analyze its effect on the performance of GK's diving save.
Methods
The diving save was studied in ten elite GKs in 4 different conditions: their preferred stance width (SW1), a stance width equal to 50% of leg length (SW2), 75% of leg length (SW3), and 100% of leg length (SW4). A 200 Hz passive marker motion analysis system was used, with two force plates to capture the mechanical variables of 4 types of dives towards high and low balls on both sides. Balls were hanging statically in the four corners of the goal. A light switch indicated to which ball subjects were to dive as fast as possible. Two-way repeated measures ANOVA was used to compare dive time between conditions and heights.
Results
There was a significant effect of stance width and ball height on dive time, the fastest dive being for the SW3 condition with an average time of 1.05 s for high balls and 0.972 s for low balls. Pairwise comparisons showed that SW3 was significantly faster than SW1 (33 ms), SW2 (34 ms) and SW4 (32 ms). The actual averaged stance width at the instant of contralateral push-off (first push-off) was 87% of leg length, and at the ipsilateral push-off (last push-off) was 78% of leg length.
Discussion
The GK was more efficient in SW3 than narrower stance widths SW1 and SW2, probably because less countermovement was used and because a smaller step was made towards the ball before the ipsilateral leg could contribute to push-off. This effect was exaggerated in SW4, where almost no countermovement took place which increased the time of high dives, by decreasing the center of mass (COM) vertical acceleration after push-off. In SW3, the push-off appeared to be more effective than the other conditions as the COM was accelerated faster towards the ball and body angular momentum increased at a faster rate. Coaches should emphasize stance width in their instruction for GKs, because the small time difference between SW3 and SW1 reflects a travel distance of the ball of 1.2 m in a penalty situation, and a 20 cm longer reach of the GK at ball contact.

NO DIFFERENCES IN MUSCLE AND TENDON TISSUE PROPERTIES OF COMPETITIVE FOOTBALL GOALKEEPERS AND MIDFIELDERS: A PILOT-STUDY

KONRAD, A., TILP, M.
KARL- FRANZENS- UNIVERSITY GRAZ

Introduction
Adaptations in the muscle tendon unit (MTU) due to training have been reported to be specific according to the different physical requirements in different types of sports (Arampatzis et al. 2007). In football the movement of a goalkeeper (GK) is short and explosive, whilst field players have stronger requirements on endurance (Knoop et al. 2013). Due to these differences in movement behavior it is reasonable that football players in different playing positions (especially midfielders (MF) vs. goalkeepers) react with different adaptations on the MTU. Therefore, we hypothesized that GK would demonstrate higher maximum voluntary contraction (MVC) and higher tendon and/or muscle stiffness compared to MF and non-active controls.
Methods
Twenty-one healthy male participants (mean±SD; 22.5±2.4 years, 179.0±6.1 cm, 75.4±10.0 kg) volunteered in this study. According to their activity profile they were assigned to a GK group (n=7), a MF group (n=7), or a control group (n=7). To determine possible differences in the MTU between the three groups, the range of motion (RoM), passive resistive torque (PRT), MVC, muscle stiffness, tendon stiffness, pennation angle, fascicle length, and muscle thickness of the gastrocnemius medialis muscle were determined with dynamometer and ultrasound measurements. ANOVA tests with post hoc Bonferroni corrections were performed to detect differences in mean values. Pearson correlation was used to relate training volume and MVC.
Results
There was no significant difference in RoM, PRT, muscle-tendon stiffness, and the examined structural parameters (e.g. tendon stiffness) between the three groups. However, we found a significant difference in MVC between the soccer players (GK and MF) and the controls (P=0.02, P=0.01), but not between the athlete groups. Effect sizes in all parameters between the GK and MF were low (range from 0 to 0.45; mean: 0.19 SD±0.14). Additionally, our data showed a positive correlation between the training volume and MVC (r=0.58; P=0.01).
Discussion
While Arampatzis et al. (2007) showed higher MVC and tendon stiffness in sprinters compared to endurance athletes we could not observe such differences between GK and MF. However, our data showed that habitual training leads to higher muscle strength in football players compared to less-active persons. We conclude that playing position in football training and competition does not lead to specific muscle and tendon architecture adaptations. Low effect sizes observed indicate that the lack of significant difference was not due to low number of subjects.
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Contact
andreas.konrad@uni-graz.at

WITHIN SESSION SEQUENCING EFECTS OF BALANCE AND PLYOMETRIC EXERCISES ON PHYSICAL PERFORMANCE IN YOUTH SOCCER ATHLETES

CHAOUACHI, A., CHAOUACHI, M.M., MAKHLOUF, I., HAMMAMI, R., GRANACHER, U., BEHM, G.G.
TUNISIAN RESEARCH LABORATORY SPORTS PERFORMANCE OPTIMISATION

Introduction
Hamammi et al. (2016) demonstrated that sequencing 4 weeks of balance training followed by 4 weeks of plyometric training produced either similar or superior performance enhancements in youth soccer athletes compared to the reverse order. Besides the blocked/sequenced combination of balance and plyometric training, these two training regimens can also be integrated as same-session combined training. The objective was to examine the effect of 8 weeks of balance and plyometric training either conducted in the form of blocked training sessions or when applied as alternating exercise pairs on measures of physical fitness in youth soccer athletes. It was hypothesized that the blocked form (BBPT: block of all balance exercises before plyometric training exercises) would result in larger performance enhancements because blocked balance exercises are conducted in a rested state while the alternated form (ABPT: a series of two paired exercises, which alternate balance exercises before plyometric training exercises) may induce fatigue due to the combination of a balance with a plyometric exercise
Methods
Twenty-six young elite soccer players trained twice per week for 8 weeks that either alternated balance or plyometric exercises or performed a block of balance exercises prior to a block of plyometric exercises within each training session. Testing was conducted pre- and post-training and included proxies of strength, power, agility, sprint, and balance such as countermovement jumps, isometric back and knee extension strength, standing long jump, 10 and 30-m sprints, agility, standing stork, and Y-balance tests.
Results
Results indicated that both groups exhibited significant, generally large magnitude training improvements for all measures with mean performance increases of approximately >30%. There were no significant differences between the training groups over time measures.
Discussion
The results from the present study illustrated no significant training differences whether the balance and plyometric exercises were alternated in pairs or alternated as blocks of exercises. As the balance exercises are lower intensity activities, whether they are performed in an alternating fashion or as blocks, they did not promote significant fatigue to the subsequent plyometric exercises. The large magnitude and relative changes with either of these routines might be facilitated by transient improvements in balance or a potentiating effect of the prior exercises. While balance exercises should be emphasized early in the training program for youth and preferably prior to plyometric training (Hammami et al. 2016), the sequence of within training session balance and plyometric exercises does not significantly affect the training outcomes.
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EXPLOSIVE TECHNICAL ACTIONS INCREASE FATIGUE INDEX IN THE RSA UIRFIDE SOCCER TEST

BLASCO-LAFARGA, C., DONFRANCESCO, G., MONTOYA, A., MONTEAGUDO, P., CORDELLAT, A., ROLDÁN, A., SANCHIS-SANCHIS, R.

UIRFIDE–RESEARCH GROUP. UNIVERSITY OF VALENCIA (SPAIN).

Introduction
Repeated Sprint Ability (RSA), a complex capacity related to both neuromuscular and metabolic demands, requires specificity while training and testing (Bangsbo, Mohr et al. 2006). The assessment of the capacity to repeat linear sprints was first substituted by shorter sprints including changes of direction (COD) (7x34.2 m/25s; Bangsbo 1994), and later by more specific tests where variations in distances, rests, COD's angles, or even the introduction of jumps, became a matter of study (Buchheit, Bishop et al. 2010, Hader, Mendez-Villanueva et al. 2014). However, few research has focused in the loss of velocity on RSA when short sprints, COD and jumps are combined with technical actions such as brief explosive accelerations conducting and passing the ball (C&Pb), which is the aim of this study.
Methods
13 professional soccer players of Valencia C.F (18±1.71y; 68.49±6.07kg) performed the Bangsbo (1994) test (BT) and the RSA-UIRFIDE-Soccer-Test (UST), separated by one week. UST comprises 7*10m segments, grouped in 3 sections: A) COD sprints: (10m+2x10m)/5s; B) 2x10m left COD with C&Pb; and C) 2x10m right COD with C&Pb; interspersed by 15s of rest. This triple structure in repeated 6 times, with 5s to make a CMJ and 15s left to start again. B and C sections start with an explosive dribble action. The fatigue index (FI; Fitzsimons, Dawson et al. 1993), BLa, RPE_10 and HRmax were analyzed looking for differences in physiological fatigue and loss of velocity between BT and the A-section in UST (UST_A). Student's T-test or Wilcoxon-test for related samples were applied.
Results
UST_A induced significantly larger losses of velocity (IF: 8.71±4.95% vs 3.63±1.52%; $p<0.01$) and higher HRmax (191.50± 2.32 vs 180.69±11.87 bpm; $p<0.05$), for a similar($p>0,05$) final Bla (8,75±2,32 vs 8,30±1,44 mmol-1) and RPE_10 (9.67±1.80 vs 8.75 ±2.22).
Discussion
Start-stop actions are highly demanding (Hader, Mendez-Villanueva et al. 2014), so explosive technical actions might increase fatigue. Short distance, COD and 5s-rest in UST might also help. Since loss of velocity is preserved, the introduction of more complex and specific situations should improve the quality of performance testing.
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Oral presentations

OP-PM17 Combat sports

PHYSIOLOGICAL RESPONSES AND ENERGY EXPENDITURE MEASUREMENT DURING SIMULATED TAEKWONDO COMBAT PAD-WORK PROTOCOLS: INFLUENCE OF DIFFERENT WORK:REST RATIOS.

LANGAN-EVANS, C.1, SHEPHERD, S. O.1, MORTON, J. P.1, CLOSE, G. L.1

LIVERPOOL JOHN MOORES UNIVERSITY

Introduction
The challenges of studying the energetic expenditure and physiological responses of Taekwondo combats are complex. The full contact nature of the sport makes it difficult to assess both energy systems and expenditure contributions during competition (Hausen et al., 2017). Taekwondo combat simulations have also been shown as ineffective in replicating the physiological responses of actual competition combats (Bridge et al., 2013). Therefore the aims of this study were twofold: 1. to assess the physiological responses of a range of simulated Taekwondo combat pad-work (STCP-W) protocols and to determine their ecological validity and 2. to validate the reliability of a portable actigraphy unit versus indirect calorimetry for the assessment of activity energy expenditure (AEE) during these protocols.
Methods
10 elite male Taekwondo athletes completed the STCP-W protocols in random order. Each protocol was set at differing work:rest ratios, where work was defined as 2 seconds of technical kicking efforts, classified into Condition 1 (1:7 - Easy), Condition 2 (1:5 - Competition) and Condition 3 (1:2 - Hard). Participants were assessed for oxygen uptake using indirect calorimetry, heart rate (HR), blood lactate (BL) and ratings of perceived exertion (RPE) and wore a portable actigraphy unit throughout. Statistical analysis was conducted using a two way within subjects ANOVA and sphericity was assumed using the Mauchly test. Least squares regression was used to assess validity where between STCP-W protocol conditions, actigraphy measurements were regressed individually against each indirect calorimetry assessment (Hopkins et al., 2009).
Results
HR, BL, RPE and indirect calorimetry values all showed differences ($P < 0.05$) within and between conditions validating the differing STCP-W protocols as measures of workload intensity. Estimates of AEE using actigraphy measured against indirect calorimetry demonstrated greater validity in Conditions 1 and 2 compared to Conditions 3 as indicated by less fixed and proportional biases.
Discussion
Despite being much higher in workload intensity Condition 3 values compared best with actual competition physiological demands reported in the literature and the same work:rest ratios could be considered by coaches for training interventions. The portable actigraphy unit differed to indirect calorimetry measurements in Conditions 1 and 3 and measurement error increased in tandem with increases in workload intensity. However, the error of measurement could be regarded as ecologically minimal and further study around the use of portable actigraphy in Taekwondo training and competition is warranted.
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ENERGY SYSTEM CONTRIBUTIONS IN UPPER- AND LOWER-BODY WINGATE TESTS IN JUDO ATHLETES

FRANCHINI, E.1, PANISSA, V.L.G.1, CURY, R.L.1, AGOSTINHO, M.F.1, ESTEVES, J.V.D.C.2, JULIO, U.F.1

1:EEFE-USP (SÃO PAULO, BRAZIL); 2: ICB-USP (SÃO PAULO, BRAZIL)

Introduction

While the characterization of energy system contribution in the lower-body was more explored, little information exists about upper-body Wingate test (WAnT) (Harvey et al. 2015; Price et al. 2014), especially in athletes engaged in both lower- and upper-body high-intensity training. Thus, this study compared the energy system contribution and the relationship between mechanical and energy system variables in upper- and lower-body WAnT in judo athletes.

Methods

Eleven judo athletes (18±1 years-old, 174.3±5.3 cm, 72.6±9.9 kg, 11.8±1.7 % body fat) attended the laboratory on two occasions, separated by at least 72 hours and at the same time of the day, to perform two WAnT (upper- and lower-body) and two incremental tests (upper- and lower-body). The estimated energy contribution for the oxidative, glycolytic and phosphagen (ATP-PCr) systems were calculated based on oxygen consumptions (VO2) during WanT, delta of lactate and the fast phase of excess VO2, respectively (Beneke et al., 2002).

Results

Concerning the performance and physiological variables, higher values were observed for the lower-body, except for fatigue index, which was higher during the upper-body WanT. Similar values were observed in upper- and lower-body for the oxidative (21±4% vs 23±3%) and ATP-PCr systems (29±6% vs 32±5%), but the glycolytic system (50±5% vs 45±4%) and anaerobic power reserve were higher in the upper-body (468±86 vs 262±52% of maximum aerobic power). In upper-body WanT there were significant relationships between mechanical variables and glycolytic (r= 0.60 to 0.79) and oxidative systems (r= 0.66 to 00.70), while in lower-body WanT the mechanical variables were significantly correlated with ATP-PCr (r= 0.65 to 0.97) and oxidative systems (r= 0.60 to 0.74).

Discussion

Harvey et al. (2015) investigated physically active individuals, using the same methods as in the present study, and reported similar findings as ours, i.e., higher relative glycolytic contribution in the upper-body WanT (60 ± 6% vs 47 ± 7%), but different concerning the ATP-PCr (37 ± 6% vs 28 ± 5%) and oxidative contributions (17 ± 3% vs 11 ± 1%) that were higher in the lower-body WanT. In conclusion, during a WanT the glycolytic contribution provides the higher proportion of energy, and this contribution is higher in the upper- compared to lower-body. Moreover, there is a distinct relationship between mechanical and energy system variables in upper- and lower-body WAnT.

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Contact

efranchini@usp.br

ACUTE EFFECTS OF DIFFERENT WARM UP PROTOCOLS, ON 30 M. SPEED, FLEXIBILITY, VERTICAL JUMP, STRENGTH, BALANCE AND ANAEROBIC POWER PERFORMANCES IN JUDOKAS

EKEN, Ö., VAROL, S.R., ÖZKOL, M.Z.

INONU UNIVERSITY

Introduction

Warm up protocols before judo training or competition has become one of the most important topics for coaches and practitioners and recent studies have shown some positive effects on performance (Fradkin et al, 2010). For decades, practitioners have prescribed warm ups to prevent injuries, improve range of motion, decrease muscle soreness and enhance the performance of their athletes (Bishop, 2003). Therefore the purpose of this study was to examine the acute effects of different warm-up protocols, on 30 meter (m) speed, flexibility, vertical jump, strength, balance and anaerobic power performances in judokas.

Methods

Twenty healthy male active judokas who are at the ages of 11-14, voluntarily attended to this research. This study is available just one group in which was included 20 people and there isn't any control group. Four different warm up protocols which have been applied with content for 48 hours. Repeated four different measure of nonparametric was performed Friedman test and difference due to which measure to find out was applied dual pairing made to the Wilcoxon test. SPSS 18.0 statistic program (SPSS Inc, Chicago, IL) is used in data analyses and $p<0.05$ is accepted as statistics significance level.

Results

When 30 m speed values are investigated, among four different warm up protocols, $p<0.05$ level difference is found between no warm up (NWU) and combine warm up (CWU), $p<0.05$ level difference is found between static warm up (SWU) and dynamic warm up (DWU), $p<0.001$ level significant difference is found between SWU and CWU. When flexibility measurement values were investigated, among 4 different warm up groups, no significant difference is found ($p>0.05$). When we compare the applications of leg strength performance, $p<0.01$ level significant difference is found between NWU and CWU group and $p<0.05$ level significant difference is found between SWU and CWU group.

Discussion

It was observed that different warm up protocols had a positive effect on 30 m speed, flexibility and leg strength performance. CWU had positive effects before 30 m speed and leg strength performance. In addition SWU had positive effect on flexibility performance. As a result of this study, male judokas may suggested to perform CWU in the skills of based on speed and strength performance before training, and SWU may suggested before the skills to improve flexibility performance.

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Contact

ozgur.eken@inonu.edu.tr

STANDARDIZING A WHOLE-BODY ACCUSTIC-BASED ENDURANCE TEST IN U15 GERMAN JUDO ATHLETES – APPROACHING PERCENTILE RANKS

KIRBSCHUS, K., VOGT, T.

GERMAN SPORT UNIVERSITY

Introduction

Running exercises are often used to determinate endurance capacity for judo athletes. Although several judo-specific tests that seem to be more applicable to the sport have been suggested, the economic application may be questioned, in particular when testing large groups of judo athletes. Therefore, the present study aimed to standardize an easy to apply Judo Beep Test (JBT), commonly used for judo-specific endurance testing in young German judo athletes.

Methods

154 talented male (age 13.6 ± 0.5 yrs; weight 50.1 ± 12.9 kg) and 107 female athletes (age 13.6 ± 0.6 yrs; weight 52.8 ± 11.0 kg) completed the JBT at the German Judo Federations' central screening for u15 year-olds. After weighing, the JBT was the first in a test battery, characterized by the following criteria: 1) the lined distance covered between beeps corresponds to 8 m on a judo mat; 2) with their hands contacting their thighs, at beeping the athletes have to push-up from behind the line and start moving; 3) between two beeps one judo role is performed in a centred target zone (2 meters). Using the original audio protocol from the 20 m Shuttle Run Test (Legér et al. 1988), an additional loop-sound (indicating the judo role) in the middle of each shuttle was added.

Results

Male athletes (60 ± 18 change in direction, CID) completed more changes in direction (CID; $p>0.01$) compared to female athletes (48 ± 15 CID), while there were no gender-specific differences in age ($p>0.05$) and weight ($p>0.05$). CID and weight (males $p<0.01$, $r=-0.424$; females $p<0.01$, $r=-0.532$) as well as weight and age (males $p<0.01$, $r=0.439$; females $p<0.01$, $r=0.397$) correlated, whereas CID and age (males $p>0.05$, $r=-122$; females $p>0.05$, $r=-0.135$) revealed no significant correlations. CID male percentiles are 10%=38, 20%=45, 30%=50, 40%=54, 50%=57, 60%=62, 70%=68, 80%=75, 90%=85; CID female percentiles are 10%=30, 20%=34, 30%=39, 40%=44, 50%=47, 60%=50, 70%=55, 80%=60, 90%=65.

Discussion

Weight and endurance capacity correlating results are in line with previous findings in adult athletes (Callister et al. 1991), whereas the present study's correlations between age and weight as well as the found sex differences in CID may be attributed to physiological advantages as of natural biological developments due to inserting puberty. Although differences in weight groups were observed (e.g. less CID in heavier athletes); future data and, thus, a larger sample size may reveal weight group-oriented standardization.

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QUANTIFYING NEUROMUSCUALR FATIGUE INDUCED BY REPEATED THAI-STYLE ROUNDHOUSE KICKS

CIMADORO, G.1, BABAULT, N.2

SHAS, ST MARY'S UNIVERSITY TWICKENHAM (LONDON, UK)1; UFR STAPS, UNIVERSITY OF BURGUNDY (DIJON, FRANCE)2

Introduction

Muay Thai is a martial art based on punches, elbow-strike, knees-strokes and a variety of kicks. The middle kick is the most used and powerful kicking technique (Sidthilaw, 1996). However, kicking training is based on experience leading to suboptimal improvements and/or excessive fatigue. Thus, the goal of this study was to examine the effect of an acute bout of middle kick striking on neuromuscular fatigue (CMJ kinetics) (Cormie et al., 2009) under two traditional conditions.

Methods

Nine professional male Muay Thai fighters (age 20 ± 4 y, height 176 ± 6 cm, body mass 68 ± 7 kg) took part to this randomized cross-over trial. All were experienced (training 13 ± 1 h/week, practice time 6 y ± 2, fights number in their career 15 ± 12) and lower-limb injury free in the past two months. After warm-up fighters performed 5 maximal CMJs (pre-tests) on a force plate (Capstone, PASCO, USA) with 30-second rest between trials. Two kicking protocols were performed on an indoor Muay Thai gym using a 60 kg heavy bag. The first protocol (H3) consisted in striking the bag a total of 20 times as hard as possible every 3 s alternating right and left leg, while for the second protocol (H1) the interval between strikes was reduced to 1 s. Three CMJ trials (post-tests) with a rest of 30 s between them were conducted immediately, 5 minutes, 10 minutes after the intervention (post, post5, post10, respectively).

Results

No difference was observed between conditions (H1 vs. H3). However, CMJ max height significantly decreased after both striking modes (H3 -5.2% ± 5.3; H1 -5.3% ± 4.1) and remained significantly lower than baseline ($P < 0.05$). Peak force in H3 condition significantly decreased (-3.7% ± 5.2; $P < 0.05$) at post10. Peak power was significantly lower than baseline after both middle kicks modalities (H3 -4.6% ± 3.5; H1 -4.5% ± 3.1; $P < 0.05$). A slight but significant increase was observed at post5 for H3 condition but decreased further post10. In contrast, for H1 condition peak power remained unaffected after the first 10 minutes.

Discussion

No interaction effect indicates that striking types (i.e. H1, H3) induce comparable fatigue. However, the overall trend suggests that striking affected CMJ performance mainly the first minutes from the end of the effort (Rodacki et al., 2002) and a potentiated effect also occurred. Further research is necessary to explore the nature of kick-specific neuromuscular fatigue.

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Contact

giuseppe.cimadoro@stmarys.ac.uk

EPIDEMIOLOGY OF COMPETITION INJURIES IN OLYMPIC-STYLE JUDO ATHLETES: A PROSPECTIVE COHORT STUDY

DUŠANA, C., MILOŠ, Š., LENKA, M., REIDAR, P.
COMENIUS UNIVERSITY

Introduction
Judo is an Olympic combat sport characterised by its combination of standing and ground fighting without the use of striking techniques. There is a general scarcity of injury data, conflicting injury incidence rate estimates, and paucity of identified risk factors for injury in judo (Pocecco et al, 2013). Hence, the main objectives of this study were to determine the injury incidence rate and injury pattern, and to identify risk factors for injury, among elite adult European judo athletes.
Methods
Data were collected at the 2015 U23 European Judo Championships, which was held in Bratislava, Slovakia. Injury incidence rates (IIR) were calculated per 1,000 athlete-exposures and per 1,000 minutes of exposure with 95% confidence intervals (CIs). Subgroups were compared by calculating their rate ratios (RR) with 95% CIs.
Results
The overall IIR was found to be 35.6 (95%CI 22.8–53.0) per 1,000 athlete-exposures, or 10.9 (95%CI 7.0–16.2) per 1,000 minutes of exposure. The most frequently injured anatomical region was the head/neck (41%), while the most common type of injury was contusion/haematoma (33%). The risk of injury was almost four times greater for athletes losing a bout compared to winners (RR 3.80 [95%CI 1.47–9.82]). The risk of injury was greater in middle weight divisions compared to light weight (RR 3.58 [95%CI 1.24–10.35]) and heavy weight (RR 2.34 [95%CI 0.93–5.89]). Females had a slightly higher injury incidence rate compared to males, but the difference was not significant (RR 1.33 [95%CI 0.61–2.90]).
Discussion
To the best of our knowledge, this is one of the largest prospective studies of the epidemiology of sport judo competition injuries to date, and the first to report exposure-time adjusted injury incidence rates. The overall IIR and injury pattern in the present study was similar to that in previous reports on adult judo athletes, but appear to differ from that reported in karate and taekwondo (Arriaza et al,2005; Sterkowicz et al, 2013; Lystad et al, 2009). Middle weight and female judo athletes appear to be at greater risk of injury, suggesting that more targeted injury prevention strategies may be warranted. Future research is encouraged to investigate the actual severity of judo injuries.
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Oral presentations

OP-PM62 Methods and exercise physiology 1

WEELCHAIR BASKETBALL: ARE ARM CRANK AND WHEELCHAIR TREADMILL ERGOMETRY SUITABLE ASSESSMENT TOOLS?

REER, R., OTTO, A.K., SCHROEDER, J., BRAUMANN, K.M.
UNIVERSITY OF HAMBURG

Introduction
Assessing training program in competitive wheelchair basketball players is essential for successful competition and performance (1,2,3). The aim of this study was to compare arm to treadmill wheelchair ergometry and to determine various metabolic and respiratory thresholds to provide athletes with optimal training prescription and training program.
Methods
5 male and 3 female wheelchair basketball players (age: 29.3+2.9yrs; BW: 68.0+14.3kg; Ht: 164.5+20.6cm) of the first German division participated in this study. Participants were tested twice, once via arm crank and again via wheelchair treadmill ergometry in randomized order. Measured threshold variables were: blood lactate concentration (LA mmol.l-1), heart rate in beats per minute (HR bpm), power output in Watts (PO), energy expenditure (EE, Kcals), oxygen uptake (VO2 ml.kg-1.min-1) and maximal performance expressed in percent (%). The data were calculated for differences via non-parametric statistical analysis, correlation and statistical significance (r; $p<0.05$). The data was assessed according to two different concepts previously reported by Dickhuth and by Mader.
Results
When considering Dickhuth concept, our results yielded significant differences for LA ($P<0.025$), EE ($P<0.012$), VO2 ($p<0.012$) and maximal performance ($p<0.036$). According to Mader concept, we found significant differences for HR ($p<0.012$), EE ($p<0.012$), VO2 ($p<0.012$) and maximal performance ($p<0.02$). When utilizing Dickhuth concept, results yielded significant correlation for EE ($r=0.81$; $p<0.015$) only; while Mader concept revealed significant correlation for HR ($r=0.76$; $p<0.031$), EE ($r=0.81$; $p<0.015$) and maximal performance ($r=0.81$; $p<0.015$).
Discussion
Our results revealed that measures generated from arm crank vs. wheelchair treadmill ergometry are not useful to monitor training prescription. The large and expected significant differences in VO2 uptake alone between arm and treadmill tests lacked usefulness of the tests. We therefore recommend using treadmill test for wheelchair basketball players as it better mirrors demands of wheelchair basketball competition.
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Contact: ruediger.reer@uni-hamburg.de

A CROSS-SECTIONAL STUDY ON SARCOPENIA USING DIFFERENT METHODS: REFERENCE VALUES FOR HEALTHY SAUDI YOUNG MEN

AL-KAHTANI, S.

KING SAUD UNIVERSITY

Introduction
The aim of this study was to determine reference values for sarcopenia indices using different methods in healthy Saudi young men.
Methods
Participants included 232 Saudi men aged between 20 and 35 years. The study measured anthropometric indices, blood pressure, hand grip strength, and lean muscle mass using dual-energy X-ray absorptiometry (DXA), and bioelectrical impedance analysis (BIA) was performed using Inbody 770 and Tanita 980 devices.
Results
Using DXA, the mean value of appendicular lean mass divided by the height squared (ALM/ht2), which is considered the main sarcopenia index, was found to be 8.97±1.23 kg/m2; hand grip strength measured 42.8±7.6 kg. While the differences between DXA and BIA (Tanita) were significant for all parameters, the differences between DXA and Inbody values were significant only for ALM parameters. Inbody sensitivity and specificity values were 73% and 95.9%, respectively. The kappa ($P = 0.80$) and p values ($P < 0.001$) showed good agreement between Inbody and DXA, whereas Tanita sensitivity and specificity values were 54.2% and 98.3%, respectively. Bland-Altman plots for differences in lean mass values between Tanita, Inbody, and DXA methods showed very high bias for Tanita and DXA, with significant differences ($P < 0.001$).
Discussion
The cut-off values for sarcopenia indices for Saudi young men are different from those of other ethnicities. The use of tailored cut-off reference values instead of a general cut-off for BIA devices is recommended.

ESTIMATION OF THE MECHANICAL POWER FOR THE SELF-MOVEMENT OF THE EXTREMITIES IN THE ENDURANCE SPORTS DEPENDING ON THE MOVEMENT FREQUENCY

CLAUSS, M., PORTELA, J., HARTMANN, U.

UNIVERSITY OF LEIPZIG

Introduction
In the context of physiological performance diagnostic in endurance sports the overall load of athletes is determined using gas exchange metabolism. However, this does not provide precise information on the share of energy expenditure which is directly implemented in the propulsion. The periodic acceleration and deceleration of relatively large partial masses like the extremities does not lead directly to propulsion in these sports. On the other hand, a discontinuous translatory system drive of the multi-body system is not possible without these self-movements. The question focuses to the attributed magnitude of the energy and power to the movement of the extremities, which may be important in the case of an increase in the motion frequency. Only Zaciorskij˙s et al. (1987) experiments estimated and quantified some results.
Methods
Based on the definition equation for the kinetic energy of a multi-body model consisting of articulated rigid bodies as well as the Freudenstein equation (Ghosal, 2010) a simulation application was developed in Wolfram Mathematica. Calculating the central moments of inertia for the extremities is based on the anthropometric data of the athletes. The simulation results were verified in experimental tests in cycling, cross-country skiing and canoeing by means of 5 athletes.
Results
The energy for the self-motion of the extremities increases with the square of the motion frequency and the power (differentiation of the kinetic energy over time) with the third cube of the motion frequency. On the other hand, the potential energy is only linearly dependent on the motion frequency, the angle of inclination and the respective position of the last link of the kinematic chain or the anthropometric data of the athlete. For a given mechanical power of a motion simulator (cycle ergometer, treadmill, flume), the kinetic energy for overcoming inertial force and acceleration of the partial masses during cycling was increased up to 35% (180 rpm), double poling up to 18% (75 cycles/min) and paddling up to 14% (140 strokes/min). Maximum performance of up to 3 kW / 1.7 kW / 1.4 kW can be performed by the athletes. The experimental results differ only 5%, 12% and 7% from the simulation results.
Discussion
The energy of the self-movement of the extremities should especially not be ignored in endurance sports. It must be added to the energy for the production of translational propulsion. The calculation of physiological efficiency must be taken into account.
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THE IMPACT OF LOAD CARRIAGE ON LADDER ERGOMETER CLIMBING

BARRON, P.J., BURGESS, K., COOPER, K., STEWART, A.D.

ROBERT GORDON UNIVERSITY

Introduction
Industry fitness standards for occupational groups should reflect the real word demands placed on the workforce and be based on published peer reviewed work (Peterson et al 2016). Currently, very limited research relates to vertical ladder climbing and less specifically to wind turbine technicians. This study addressed this gap and assessed the effect of load carriage typically borne by wind technicians on vertical ladder climbing.
Methods
Fourteen participants (12 male and 2 female healthy participants aged 20.4 (± 2.3) years with stature 174.2 (± 7.4) cm and mass 68.8 (± 7.4) kg took part. Each carried no load, 5 kg and 10 kg in a randomised order, attached to a Petzl Volt Wind Harness (Petzl, France). After completing a 5 minute warm up climbing vertically on a ladder ergometer at 7 m per minute, 3 x 5 minute loaded climbing bouts at 7.52 m per minute were completed. Heart rate (HR) and VO2 were monitored throughout with the mean value determined from the final minute of each stage and a rating of perceived exertion (RPE) from a 10 point Borg scale recorded at the end of each stage. A repeated

measures ANOVA was used to assess the effect of load on both HR and VO2 with a Bonferroni post-hoc test and significance set at $p < 0.05$. A Friedmans ANOVA was used to assess the change in RPE (Field 2012).
Results
VO2 was significantly greater ($p < 0.05$) for the 10 kg load (40.10 (± 4.00) ml/kg/min) than both the no load (36.03 (± 3.95) ml/kg/min) and 5 kg (37.78 (± 3.63) ml/kg/min) condition. However, no significant difference was observed between no load and 5 kg. The HR response to the 10 kg load (164.4 (± 18.4) bpm) and 5 kg load (160.1 (± 21.4) bpm) was significantly higher than that of no load (151.9 (± 25.2) bpm) but the difference between the 5 kg and 10 kg load was not significantly different. Friedmans ANOVA showed a significant change in RPE. The median RPE was 3.5 for no load,5 for the 5 kg load and 6.5 for the 10 kg condition.
Discussion
These data suggest loaded vertical climbing requires a critical loading threshold to be exceeded before a significant increase in demand is demonstrated by increased oxygen consumption. However, individuals reported that any increased load made the climbing feel harder. Therefore the load carried by ladder climbers should be carefully considered as it may influence ladder climbing response, recovery and performance of subsequent tasks. This should be taken into account when defining a potential fitness standard for the wind energy industry, because the demand of vocationally-specific loading may not correspond to unloaded vertical climbing.
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MORE INSIGHT INTO ANAEROBIC CAPACITY: W' AND ANAEROBIC WORK PERFORMED COMPARED

TE POELE, K.J.A., NOORDHOF, D.A., LEVELS, K., DE KONING, J.J.
VRIJE UNIVERSITEIT AMSTERDAM

Introduction
Both aerobic and anaerobic capacity influence exercise performance in a variety of sports. Aerobic capacity can be measured accurately, but anaerobic capacity has to be determined indirectly. The Critical Power (CP) method to determine W', and the Gross Efficiency (GE) method to determine anaerobic work performed (AW) are, amongst others, being used to determine the anaerobic capacity. As a gold standard to determine the anaerobic capacity is currently lacking (1) and both methods have not been compared yet, the aim of this study was to compare W' and AW, using the CP method and GE method, respectively.
Methods
After a maximal incremental exercise test and a familiarization time trial, nine trained male cyclists performed cycle ergometer tests to determine anaerobic capacity via the CP method and GE method. A 3-minute all-out test was performed to estimate W' (2), and a 2-km time trial with a submaximal exercise bout prior to and after the time trial, was used to estimate AW(3). Gas exchange and power output data were continuously measured. The magnitude-based inferences Approach (4) was used to assess the difference between the two measures of anaerobic capacity. Data is reported as mean ± CV (%).
Results
The 3-minute all-out test resulted in a mean W' of 11599 J ± 33. The 2-km time trial resulted in mean AW of 17560 J ± 13.1. The difference in anaerobic capacity was 51.4%; 90% confidence limits: ±28.2%. The mean estimated AW was most likely larger than mean estimated W'.
Discussion
The difference in anaerobic capacity might be due to the incorporated decline in GE, using the updated GE method (3). The CP method does not account for this decline, which might be one of the shortcomings of this method. As a declining GE during high-intensity exercise results in a decrease in the relative contribution of the aerobic energy system and an increase in the relative contribution of the anaerobic energy system. When AW was calculated assuming a constant GE, the anaerobic capacity tended to be lower and approached W'. Considering the difference between both methods, the CP method and the GE method, used to determine the anaerobic capacity, should not be used interchangeable.
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Contact
karlijntp@hotmail.com

SIMULATED ECCENTRIC AND CONCENTRIC SHOCKS - IMPACT ON FORCE, TIME AND KNEE ANGLE PARAMETERS

RASCHNER, C., MUTSCHLECHNER, L.
UNIVERSITY INNSBRUCK

Introduction
In some competitive sports (e.g. ski racing), athletes are exposed to very high external forces with short unexpected eccentric (CEC) or concentric (ECE) shocks in a stretch-shortening-cycle (SSC). CEC represents a slow concentric leg extension with a fast eccentric shock and ECE is a slow eccentric leg extension with a fast concentric shock. The aim of the study was twofold: first to find an adequate way to generate repeatable and standardized CEC and ECE shocks, and second to compare these shocks in terms of force, time and knee angle parameters.
Methods
Eleven strength-trained men performed ten unilateral maximal concentric and eccentric leg extensions (v=0.2m/s) with CEC and ECE shocks (v=2.0m/s) on the self-developed mechatronic driven training device (evolution). Leg extension force was recorded with a 3-dimensional force plate. Range of motion was set at knee angles 80° to 140°. The five best trials of the ten repetitions of each of the two series were collected. Force values (Fmax, Fmin), rate of force development (RFD) and rate of force lost (RFL) together with the knee angle and time parameters were analyzed. Pearson correlations assessed selected relationships. The level of significance was set at $p<0.05$.
Results
CEC shock: A mean FmaxCEC of 1440±192N at a knee angle of 105±4° was calculated. FmaxCEC occurred 75±4ms after the onset of the CEC shock with a mean RFD-CEC of 2.5±0.3N/ms. FminCEC of 1108±197N was detected 127±47ms after the end of the CEC shock. ECE

shock: An FmaxECE of 1733±273N with a knee angle 115±4° appeared 166±41ms after the end of the ECE shock with a mean RFD-ECE of 1.8±0.6N/ms. FminECE (1324±216N with a mean RFL-ECE of -4.8±0.7N/ms) occurred 67±11ms after the ECE shock release. The correlation (r=0.85, p<0.001) between FmaxECE und RFD-ECE was highly significant. There was no significant correlation (r=0.20, p=0.55) between FmaxCEC and RFD-CEC.
Discussion
The evolution training device creates standardized shocks of varied speed, structure and duration. The study showed that CEC or ECE shocks affect Fmax, Fmin, RFD and RFL differently. The significant correlation between FmaxECE and RFD-ECE showed that Fmax may be the main factor during a SSC in which FmaxECE occurred approximately 170ms after the end of the shock. In contrast, there was no significant correlation between these values during the CEC shock, in which FmaxCEC was reached only 75ms after the start of the shock. Further research is necessary to analyze the underlying mechanisms in such highly dynamic contractions (Maffiuletti et al., 2016).
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Contact:
christian.raschner@uibk.ac.at

Oral presentations

OP-SH02 History and Ethics

EARLY DEVELOPMENTAL ENVIRONMENT AND OLYMPIC SUCCESS: HISTORICAL ANALYSIS OF AN AUSTRALIAN SPORTING "HOTSPOT"

O'NEILL, K.
THE UNIVERSITY OF SYDNEY

Introduction
Inspired by the 'birthplace effect' phenomenon (Côté, Macdonald, Baker, & Abernethy, 2006), this study aimed to identify an Australian sporting "hotspot" and gain understanding of factors underpinning a proportionately high number of Australian summer Olympians experiencing their early developmental environment within the area.
Methods
A mixed-method approach was utilised to investigate the "hotspot" through collecting biographical data on all known (n=2160) Australian summer Olympians 1984-2012, followed by undertaking a case study analysis to examine the "hotspot" within the context of Bronfenbrenner's (1979; 1994) 'Ecological Systems Theory' and 'Bioecological Model'. Alongside the collection of statistical demographic and climate data, Olympians' (n=11) and community stakeholders (n=31) views regarding the "hotspot's" occurrence and its perceived influence on athletic development were gained through semi-structured interviews.
Results
Triangulated with Olympians' and community stakeholders perceptions of the "hotspot", several demographic and climatic variables pertinent to the "hotspot" were found to differ significantly from national means. Overall, results determined that several demographic, geographic, historical, individual, social and fortuitous factors likely contributed to the "hotspot's" creation.
Discussion
Although not predominantly attributable to one variable, it was evident that a confluence of planned and fortuitous factors had unintentionally created a "hotspot" of Australian summer Olympians in Perth, Western Australia. Access to built and natural facilities, climate, family influence, schools, strong community clubs, opportunity to train and compete with older athletes, access to role models, high socioeconomic status and an endemic sports culture were among key contributors to effective athlete development within the "hotspot". Despite several factors being unique to the "hotspot", those pertaining to family, access to facilities and the junior sports environment are potentially transferable to other athlete development environments in Australia and overseas. Ultimately, Olympians' considered these factors to most strongly influence their athletic development.

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SPORT – MORE THAN THE GLORY OF A GOLD MEDAL: EMPOWERING AT-RISK YOUTH THROUGH SPORT EXCELLENCE PROGRAMS

PILZ-BURSTEIN, R.1, AGMON, M.2, ZLOTNICK, C.2
1: GIVAT-WASHINGTON ACADEMIC COLLEGE OF EDUCATION 2: UNIVERSITY OF HAIFA

Introduction
Sport academies have been recognized for their achievements in preparing young athletes for the international arena. In a different sphere, the benefits of sport-based intervention programs for the advancement of at-risk youth cannot be overstated (1).
The Model
Sport – A Bridge to Education (Non Governmental Organization) has developed a model: a novel holistic sport excellence program that uses sports and the values upon which sports are founded, as a platform for self-empowerment and the cultivation of excellence in at-risk youth, with the aim of improving their mental, social and cognitive functioning (2). The strength and uniqueness of the model is enhanced by the fact that it operates in Israel solely in villages for at-risk youth, in closed educational frameworks. Thus, it has the power not only to influence the participants themselves but also other interfacing circles within the village. This model takes advantage of the duality existing in sport, being both a goal and a means of achieving another goal, e.g. a social change.

Description of the Program
Program participants, (N=30) ages 12-18, undergo daily training and social enrichment that emphasize sport's values: self-discipline, responsibility, setting and striving to achieve goals, dealing with failure and success– values that are integrated through training sessions. Most graduates complete a fitness instructor's course, and receive professional certification that ensures a basic income and social status.
Our Goals
Upon acceptance to the program, participants must meet set requirements and adhere to standards of excellence. Goals are established to enable success and ensure a positive experience through sport, building self-identification and a sense of competence. They are given a sense of belonging, stability and trust, and gain life skills. The program's impact is monitored by biannual evaluations of participants by a multidisciplinary team using a set of validated instruments. Preliminary data reveal that by the mid-second year of the program, our participants improved their dietary habits, 25% quit smoking, a number of them won running and cycling regional competitions and they increased school attendance. Some took a leading position in helping other program participants. Without this support these youth would probably not be able to escape the cycle of poverty, violence and crime.
Based on the outcome and experience of this pilot study we aim to further expand this program in Israel and to launch a similar program in Ethiopia.
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Contact
rutipb@gmail.com

OLYMPIC PHILOSOPHY AND ITS CONTEMPORARY REFLECTION

HOGENOVA, A.
CZECH OLYMPIC COMMITTEE

The Olympic Games are a breathtaking phenomenon of humanity, the whole with no boundaries can only be seen in the tension of substantial questioning. The Olympic Games also have a totally sacred character, because they are a dialogue without words, understandable to everyone on the planet
"Conflict is the sowing of everything!" is an ancient Greek wisdom from the pen of Heraclitus. It is hard to find such substance in the sentences of great philosophers. It is no coincidence that even today Heraclitus is both explicitly and implicitly admired for the depth of his fractions. Only in conflict, and here journalists may forgive me, conflict is not a war, but only a substantial dialogue, i.e. a deep and genuine dialogue, is it possible to experience what really matters. This dialogue is the essence of man, we are a dialogue and nothing more, we conduct it through speaking and through talking. The latter applies to the Olympic Games, here we do not speak in words, here the content is communicated without words, more thoroughly than speaking, here everything essential is spoken through actions, the body, the whole, substantiality. People need not know a foreign language, and yet they understand better than ever. They give their best and gift it to others in conflict with those who are doing the same. A race between athletes is a conflict, not a war, not a fight to the death as it was in the Roman amphitheater. What was the meaning? Only one, which clasps today's world! To endure in the tension of today's contradictions, because only this tension can show something unsayable, the whole without margo, a sacred marriage between heaven and earth, something that sustains the world in its permanence, validity, in its being. Everything is shown as something sacred, because the Olympic games are sacred, and we know from history that if we are reduced only to economic profit, then we die, as has already happened several times in European history.
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EVALUATION OF THE NATIONAL ANTI-DOPING CODE IN GERMANY

WÖRDEHOFF, A.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
A central challenge in modern sport is the fight against doping. It preserves sport inherent values, such as fairplay, equal opportunities for each individual athlete, health protection and integrity of sport. But how can anti-doping programs be effective?
First of all, the question arises, whether there are indicators for a successful application of the anti-doping rules. Obviously, the number of positive doping samples cannot give a valid answer. A low amount of positive doping samples could mean either a majority of athletes comply with the rules, or the anti-doping system is not working as intended.
Methods
We developed a model for the evaluation of a private set of rules (e.g. the national anti-doping code NADC of Germany). Basis for this model is a mixed-methods design. The aim of mixing quantitative and qualitative methods is not just eliminating inherent weaknesses of each approach, but delivering additional benefit to a comprehensive examination. Adhering to the practice of method triangulation, at least three methods from both fields of the empirical science have to be used. Thereby it should be ensured that the question on the level of target achievement of the NADC is answered from more than one perspective. The reliability or plausibility of an informational source for the whole context should be confirmed. To measure the level of target achievement, we examined the self set goals of the NADC in Germany. These goals are: protection of the athlete's fundamental right to compete in clean sport, fairness and equal opportunities in sport competitions, protection of the athlete's health, worldwide harmonization and coordination of the anti-doping fight, preservation of the sport inherent values and protection of its integrity. From these goals, we developed indicators which led to a selection of methods according to the aspects relevance, appropriateness and feasibility.
Results
One indicator for a successful anti-doping code is the athlete's knowledge of and compliance to the code. We chose to quantify this with a questionnaire consisting of five parts. First of all, the athletes were asked about personal data, the second part covered their knowledge of the anti-doping code, the third part asked the athletes to report about the behavior of other athletes concerning the topic of doping, the fourth part dealt with individual doping experiences and the last part with doping control and prevention issues.
Discussion

This data along with the other results (e.g. statistical data from the anti-doping control system, a survey of sport judges and studies about the international work of the national anti-doping agency of Germany) should lead to an appraisal of the effectiveness of the NADC and to recommendations for its practical implementation.

DRIVERS OF THE PUBLIC'S OPINION REGARDING ELITE SPORTS

HALLMANN, K.1, BREUER, C.1, ILGNER, M.2, ROSSI, L.1

1 GERMAN SPORT UNIVERSITY COLOGNE; 2 GERMAN SPORT AID FOUNDATION

Introduction
Elite sports foster the integration of different ethnicities (Niemann & Brand, 2008) and procures values such as Fair Play (Papp & Prisztóka, 1995). Yet, the integrity of sport actors is threatened by issues such as doping, corruption or match-fixing. Public opinion is an active decision-making process and can be defined as an observable, verbal response to an issue derived in a cognitive process (Price, 1992). Perceptions relating to trust, athletes as role models and personal and societal benefits can influence public opinion (Funahashi, De Bosscher, & Mano, 2015). The purpose of this research is to investigate the drivers of public opinion of elite sports.
Methods
A nation-wide computer assisted telephone interview was employed. Data were collected in May 2016. A total of n=2,009 interviews was accomplished. Statements relating to the perception of a) trust in sport actors, b) perception of athletes as role models, c) personal and social benefits and d) public opinion were queried. Data were analysed using structural equation modelling.
Results
The average age of respondents is 51 years and 49.8% of the sample is female.
Model fit is adequate ($x^2(119)=523.122$; $p\leq.001$; CFI=.860, RMSEA=.052(90% CI: .047-.057; pclose=.235), SRMR=.082). Trust ($\beta=.142$; $p\leq.001$) and perceived personal benefits ($\beta=.382$; $p\leq.001$) have a significant influence on public opinion. 62.0% of the variance of public opinion is explained by the model.
Discussion
The values of elite sports need to be secured as their perception (e.g. trust) is essential for a positive public opinion of sport. Values like integrity need to be actively steered by athletes and sport organisations. If this is not secured it might become more difficult to finance elite sports and have the support of the public.
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Oral presentations

OP-SH04 Determinants of PA in adults

SEASONALITY OF PHYSICAL ACTIVITY, SEDENTARY BEHAVIOR AND SLEEP IN MIDDLE AGED AND ELDERLY ADULTS OF THE ROTTERDAM STUDY

KOOLHAAS, C.M., CEPEDA, M., SCHOUFOUR, J.D., TIEMEIER, H., FRANCO, O.H.

ERASMUS MEDICAL CENTER

Introduction
According to previous studies, physical activity (PA) levels are higher in summer, while sedentary behavior (SB) increases in winter. However, few studies have addressed the seasonality of objectively measured activity levels, the association with meteorological factors or the variation of life expectancy (LE) according to its seasonality.
Methods
First, we examined the seasonality of light, moderate-and-vigorous PA, SB and sleep time in a sample of middle-aged (50-65 years), young-elderly (65-70 years) and old elderly (≥75 years). Second, we evaluated the association of the seasonality with meteorological factors. Third, we estimated the potential variation of LE according to PA and SB seasonality. Activity levels of 1,410 participants of a population-based Dutch cohort were measured for seven days (24 hours) with an accelerometer, between July-2011 and May-2016. Using predefined algorithms, the time (minutes/day) of light, moderate and vigorous PA, SB and sleep was estimated. We examined the seasonality of each activity level with cosinor analysis. Meteorological factors (ambient temperature, sunlight hours, precipitation, wind speed and wind chill) were linked with the date of measurement. Using previously published all-cause mortality risk functions for PA and SB, we calculated the potential seasonal variation of LE.
Results
Light PA was significantly higher in summer among middle-aged and young-elderly participants (16.7 and 9.21minues/day). Moderate-to-vigorous PA was significantly higher in summer only among middle-aged adults (13.7minutes/day). SB was significantly higher in winter/spring among young- and old-elderly (39.5 and 48.98minutes/day). Sleep time was significantly higher in winter in middle-aged and old-elderly adults (21.2 and 54.5minutes/day). Meteorological factors mainly affected SB and not PA; wind speed, wind chill and precipitation had the largest effect. Compared to its nadir, LE increased by 246, 165 and 142 days at the peak of moderate-to-vigorous PA seasonality; and decreased by 78, 87 and 59 days at the peak of SB seasonality, according to age group.
Discussion
Sedentary behavior had a larger seasonality than light and moderate-to-vigorous physical activity and was mainly replaced by sleep time among elderly adults. Our population replaced PA for SB under windy and rainy conditions. High SB levels can attenuate the positive effect of PA. Breaking up long periods of SB by PA of any intensity can help to reduce the health effects of physical inactivity.

ACTION FOR MEN – PARTICIPATORY ACTION RESEARCH FOR PHYSICAL ACTIVITY PROMOTION OF MEN AGED 50 PLUS

STROBL, H.1, LOSS, J.2, WARRELMANN, B.2, TITTLBACH, S.1

1: UNIVERSITY OF BAYREUTH, 2: UNIVERSITY OF REGENSBURG (GERMANY)

Introduction
Men at and over the age of 50 represent a special target group for health enhancing physical activity promotion: They experience higher mortality rates due to chronic diseases than women, but women more frequently inquire health promotion offers than men do. Community-based interventions tailored to specific groups can be effective in increasing physical activity. However, integrating scientific and practice-based evidence in the context of implementation by a participatory approach is necessary (Rütten and Gelius, 2011). The purpose of the project ACTION for men, granted by Germany's Federal Ministry of Education and Research (01EL1421D), is to explore key components of a successful participatory approach in a community setting to develop physical activity promotion interventions addressing men 50+.
Methods
Cooperative planning groups – as a specific participatory approach – were established and facilitated in two rural communities (10.000-20.000 inhabitants) involving different community stakeholders (i.e. representatives from the target group, the municipality, sports clubs and local companies). Participants carried out regular meetings (six to 20 participants per meeting) which are still ongoing. All meetings are documented using standardized field notes. Conducting a qualitative content analysis of so far 15 protocols gave insight into crucial success factors of this participatory approach.
Results
Local knowledge and network of participants helped to mobilize resources for the implementation of planned measures in both communities. However, only one community was successful in developing an innovative far-reaching approach to foster engagement in physical activity among men 50+. This seems to be due to (1) a more directive coordination of the cooperative planning process by the researchers, (2) strong support by a representative of the municipality being comfortable with taking over responsibility and (3) identification with the project by the members of the planning group, resulting in regular attendance to the meetings and voluntary take-over of arising tasks.
Discussion
A community-based participatory approach is potentially effective in fostering health enhancing physical activity among men aged 50+. Especially changes at the structural level (e.g. facilitated access to physical activity promotion offers of different sports clubs) do not seem to be possible without a strong cooperation between various community stakeholders. Summarizing, our preliminary results suggest that cooperative decision-making in combination with some members overtaking a leadership role are crucial for successful cooperative planning groups.
References
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Contact
helmut.strobl@uni-bayreuth.de

DISENTANGLING DAILY ASSOCIATIONS FROM INDIVIDUAL DIFFERENCES IN STUDYING THE INTERPLAY BETWEEN PHYSICAL ACTIVITY, SEDENTARY BEHAVIOR, BODILY PAIN AND FATIGUE IN OLDER ADULTS: A DIARY STUDY

NTOUMANIS, N., PARK, S., VELDHUIJZEN VAN ZANTEN, J., THØGERSEN-NTOUMANI, C.

CURTIN UNIVERSITY

Introduction
Little attention has been paid to within-person associations amongst light physical activity (PA), moderate-to-vigorous physical activity (MVPA), sedentary behavior (SB), and subsequent bodily pain and fatigue in older adults. The purpose of the study was to examine within-person associations between these variables and how they are partly determined by between-person differences in pain, fatigue and physical health.
Methods
Participants were 63 community-living older adults (female n = 43, mean age = 70.98 years). Questionnaires measured typical levels of PA, SB, bodily pain, fatigue and physical health. Subsequently, on a daily basis over a 1-week period, participants' levels of light PA, MVPA and SB were measured using accelerometers. Participants completed a questionnaire rating their pain and fatigue at the end of each day.
Results
Multilevel modelling revealed positive within-person associations between daily light PA, daily MVPA, and pain, as well as negative within-person associations between daily SB and pain. For individuals with higher typical levels of fatigue, there was a negative association between daily light PA, MVPA and fatigue. For individuals with better levels of physical health, there was also a negative association between daily MVPA and fatigue. For those with higher typical levels of fatigue and better levels of physical health, there was a positive association between daily SB and fatigue.
Discussion
This is the first study to examine within-person associations between light PA, MVPA, SB and subsequent daily pain and fatigue in older adults, every day for a week. Future studies in this field could build on our findings to develop targeted PA interventions for individuals with high levels of fatigue and poor health that target beliefs, barriers and benefits of being more physically active and less sedentary.

THE DIFFERENTIATED IMPACT OF PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR ON THE COGNITIVE FUNCTION OF THE BRAIN IN THE ELDERLY.

SCHWARZ, S.1, ENGEROFF, T.1, FLECKENSTEIN, J.1, FÜZÉKI, E.1, MATURA, S.2, PILATUS, U.3, VOGT, L.1, PANTEL, J.2, BANZER, W.1

GOETHE-UNIVERSITY FRANKFURT/MAIN

Introduction
Growing evidence suggests that physical activity (PA) is associated with global cognitive function.

However, PA is supposed to specifically influence certain domains of cognitive function. The purpose of this cross-sectional analysis was to systematically investigate the association between objectively measured PA and cognitive performance in cognitively healthy older adults.
Methods
The research was conducted as part of the SMART study, a RCT to explore exercise induced neuroprotective and metabolic effects on the brain in the elderly (NCT02343029; clinicaltrials.gov). Physical activity behaviour was recorded for four of seven consecutive days via accelerometry (GT1M v4.4.0, ActiGraph, Pensacola FL, USA). Data was analysed as minutes per week spent sedentary and physically active with light or moderate to vigorous intensity. The assessment of cognitive function included several psychometric tests, i.e. for working memory (digit spans), attention (Trail Making Test (TMT)-A), executive function (Stroop-Interference, TMT-B), and verbal memory (verbal learning and memory test). Mental status was screened via a multiple-choice vocabulary intelligence test and the mini-mental status examination (MMSE). Data was analysed via bivariate correlation analysis and included age, sex, education, and body mass index as covariates. Data are shown as mean ± standard deviation.
Results
Fifty-one cognitively healthy older adults (age 76 ± 7; female 28; MMSE 29 ± 1; MWTB IQ 124 ± 11) were included in the analysis. Total PA (1783 ± 478 min) was moderately associated (r= .395, p=.004) with executive function (TMT-B; 113 ± 49 sec). No significant correlations were found with regard to working memory, attention and verbal memory. Covariate analysis revealed significant correlations of light PA (1260 ± 300 min) with the TMT-difference score (TMT-B – TMT-A; 65 ± 43; r=-.297, p=.043) and the TMT-ratio score (TMT-B/TMT-A; 2.49±.98; r=-.391, p=0.007). Sedentary time (4357 ± 581 min) and moderate to vigorous PA (211 ± 204 min) did not correlate with cognitive functions.
Discussion
The present findings confirm the relationship between PA and various domains of cognitive function. Our results indicate that adherence to light physical activity is correlated to maintenance of executive function in old age. In our sample, sedentary behaviour and moderate to vigorous activities were not associated with cognitive function. Future research is warranted to further explore the impact of physical activity below currently recommended intensities.
Contact
s.schwarz@sport.uni-frankfurt.de

BEHAVIOURAL AUTOMATICITY MODERATES AND MEDIATES THE ASSOCIATION BETWEEN SELF-CONTROL AND PHYSICAL ACTIVITY BEHAVIOUR

PFEFFER, I., STROBACH, T.
MEDICAL SCHOOL HAMBURG

Introduction
Trait self-control has been shown to be associated with physical activity behaviour (Englert, 2016). However, against the theoretical assumption of the strength model of self-control (Baumeister & Vohs, 2016), self-control seems to be more important for automatic compared to controlled behaviours (De Ridder, Lensvelt-Mulders, Finkenauer, Stok & Baumeister, 2012). It is argued that self-control might facilitate the formation of adaptive habits (behavioural automaticity) and therefore enhance health behaviour through an indirect effect (Adriaanse, Kroese, Gillebaart & De Ridder, 2014). This hypothesis was tested in the context of physical activity.
Methods
Prospective design with two laboratory sessions with a week delay between the two points of measurement. Participants (N = 124) completed standardised questionnaires assessing trait self-control and physical activity automaticity as predictors and realised physical activity behaviour (after one week) as dependent variable.
Results
An interaction effect Self-Control x Automaticity was observed. The predictive power of self-control was stronger for those participants who had high behavioural automaticity compared to participants with low physical activity automaticity. Furthermore, analyses revealed that automaticity mediated between self-control and behaviour.
Discussion
Behavioural automaticity seems to be a helpful construct to specify the relationship between self-control and physical activity behaviour. The association between self-control and physical activity is moderated and mediated by automaticity. This implies that self-control might be helpful in creating effective routines. Promoting trait self-control through training and facilitating behavioural automaticity might be appropriate approaches to enhance physical activity behaviour. Future studies should conduct randomised and controlled trials to prove causal relationships.
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Contact
ines.pfeffer@medicalschool-hamburg.de

ATTITUDE AND HABITS TOWARDS REGULAR PHYSICAL ACTIVITY – LARGE SAMPLE RESEARCH IN HUNGARY

SZÉKELY, M.
EÖTVÖS LORÁND UNIVERSITY

Introduction
In order to provide a firm ground to the development tasks of university sport, we surveyed sport habits and the attitude of university students towards regular physical activity and sports facilities in a research project conducted in the Eötvös Loránd University of Sciences (ELTE), together with the National Union of Students in Hungary (HÖOK), the education administration and the National Institute of Health Development (OEFI). From the point of view of recreational habits, having a crucial impact on healthy lifestyle, the age-group from 18-23 is

of critical importance, and the behaviour of students in higher education is decisive, since in the future they are likely to become a role model for the less educated.
Method
The explorative research is based on the results of an online survey of 16.500 students (2011)a and a representative survey of 1500 young adults (aged 18-30) (2013)b. This survey is the first to examine the students' sport habits sport by sport on a weighted data – representing students in higher education by age, institution, educational level and the schedule of the training – providing frequency, level of intensity and the premises of the sport activity as well as the organizational frame of regular sport activity (2015)c.
Results
Analysing the questionnaires the students' opinion on sport facilities and its limitations as well as motivating and demotivating factors concerning sport activity can be outlined. According to the main results the percentage of university students whose regular physical activity equals or exceeds the recreational minimum is a mere 23,1% compared to the 46,5% of pupils in secondary education. Despite the fact that the number of students doing regular sport drops to its half after secondary education, 78,8% of university students consider physical activity 2-3 times a week ideal, and more than 85% of them having the opinion that sport facilities are to be provided by the university.
Discussion
The overall picture outlined from the answers gives a deep insight not only into the students' sport culture in Hungary but also provides basis for planning intervening actions to change sedentary lifestyle. To promote university sport it is important to pay attention to students' priorities and their distribution in view of the different sports and at the same time segmenting motivating communication by the attitudes and habits of the target group is also of utmost importance.

15:30 - 17:00

Invited symposia

IS-PM04 INDIVIDUALISATION IN RECOVERY SCIENCE

INDIVIDUALIZED DIAGNOSIS OF FATIGUE AND RECOVERY NEEDS

HECKSTEDEN, A.

SAARLAND UNIVERSITY

The decisive difference in performance is generally tiny in today's competitive sports. Consequently, going to the limits of bearable training load is critical for success. However, such training "on the edge" is associated with the risk of accumulating fatigue. Therefore, monitoring of fatigue and recovery is an important aspect in the regular fine-tuning of training recommendations. During the last decades numerous fatigue markers have been reported, including a wide range of blood-borne parameters as well as psychological, autonomic and performance measures. Most of these parameters are justified by a significant main effect of fatigue and a clear physiological concept. However, accuracy and precision in the assessment of fatigue status in individual athletes is limited by large variability for all parameters available. This challenge may be addressed by individualizing cut-off values for single markers and / or joint consideration of several parameters. Individualized reference values increase diagnostic accuracy by eliminating between-subject variation, which is relevant for routine markers. Scores, non-linear multivariate classifiers and other forms of parameter combinations provide means to decrease the impact of fatigue-independent variation in single markers and gain information from parameter patterns. This lecture will present some approaches for personalized fatigue diagnostics including directions for future research.

INDIVIDUAL RESPONSE TO INTERVENTIONS SUPPORTING RECOVERY

HALSON, S.

AUSTRALIAN INSTITUTE OF SPORT

Recovery from training and competition is complex, involves numerous factors and is typically dependant on the nature of the exercise performed and any other external stressors that the athlete may be exposed to. Recovery techniques range from rest and sleep, nutritional strategies, warming down and stretching, psychological recovery and hydrotherapies (cold water immersion, contrast water therapy).
Evidence for the benefits of many recovery practices is currently increasing and the mechanisms behind these improvements in performance are becoming clearer. However, considerable individual variation in responses to recovery strategies exist and is likely related to factors such as temperature, duration, frequency and timing of recovery sessions.
Accelerated and appropriate recovery can enable the athlete to continually train and perform at the highest level, and as such should be a critical element in any training and competition program, however strategies should be tailored to the individual athlete.

SLEEP AND RECOVERY IN ELITE ATHLETES - A GOOD EXAMPLE FOR LARGE INTERINDIVIDUAL VARIABILITY

NEDELEC, M.

INSEP

In elite sport, recovery strategies are required during congested schedules to alleviate post-exercise fatigue, regain performance levels, and reduce the risk of injury. Some recovery strategies such as hydration, diet, cold water immersion, and sleep are effective in their ability to counteract the fatigue mechanisms. Nevertheless, inter-individual variability regarding sleep (e.g. sleep requirements, chronotype) may have an important influence on the elite athlete population.
Regarding sleep requirements, elite athletes have considerably larger measures of variability for sleep variables (e.g. sleep latency, time asleep, sleep efficiency) compared with controls (Leeder et al., 2012). Elite athletes anecdotally report getting from 4-5 hours to 12 hours of sleep per night. In team sports, players overall report taking a long time to fall asleep after night competitions (start times ranging from 8:00 p.m. to 9:00 p.m.) but a large interindividual variability exists (sleep start: 03:00 ± 01:02 a.m.); napping behavior is also highly varia-

ble (Lastella et al., 2015). A number of socio-demographic and socio-economic variables (e.g. age, educational level) have been proposed as factors influencing sleep (Grandner et al., 2014).
Additionally, each elite athlete has a preferred sleep schedule that suits his circadian phase, i.e. a particular chronotype which is the individual's propensity to prefer activity during certain times of day. Differences between individuals regarding chronotype are partly innate, but are also shaped by environmental factors such as habitual training start time (Samuels, 2008). In opposition to the inter-individual variation regarding sleep, the schedule of the squad/training group is unique which may potentially lead to sleep restriction especially among 'night owls'. We will propose practical applications in this respect, e.g. grouping together players exhibiting similar chronotype in shared rooms in order to prevent inopportune sleep disturbance during training camps and/or away competitions.

Oral presentations

OP-PM06 Nutrition and supplements 1

FRUCTOSE AND SUCROSE INGESTION INCREASE EXOGENOUS CARBOHYDRATE OXIDATION RATES DURING EXERCISE IN TRAINED CYCLISTS

TROMMELEN, J., FUCHS, C.J., BEELEN, M., LENAERTS, K., JEUKENDRUP, A.E., CERMAK, N.M., VAN LOON, L.J.C.
MAASTRICHT UNIVERSITY

Introduction
Peak exogenous carbohydrate oxidation rates typically reach ~1 g/min during exercise when ample glucose or glucose polymers are ingested. Fructose or sucrose co-ingestion has been shown to further increase exogenous carbohydrate oxidation rates. However, sucrose co-ingestion during exercise does not seem to elevate exogenous carbohydrate oxidation rates beyond 1.2-1.3 g/min, which is typically lower than 1.3-1.8 g/min when fructose is co-ingested with glucose during exercise. To assess the impact of fructose co-ingestion provided either as a monosaccharide or as part of the disaccharide sucrose on exogenous carbohydrate oxidation rates during prolonged exercise in the same cohort of trained cyclists.
Methods
Ten trained male cyclists (VO2peak: 65±2 mL/kg/min) cycled on 4 different occasions for 180 min at 50% Wmax during which they consumed a carbohydrate solution providing 1.8 g/min of glucose (GLU), 1.2 g/min glucose + 0.6 g/min fructose (GLU+FRU), 0.6 g/min glucose + 1.2 g/min sucrose (GLU+SUC), or water (WAT). Breath samples were collected to determine the 13C/12C ratio in expired air and combined with indirect calorimetry (VO2 and VCO2) to calculate oxidation rates of total fat, total carbohydrate, and exogenous carbohydrates. Repeated measures ANOVA with treatment as within-subjects factor was used to determine differences in peak exogenous carbohydrate rates between treatments.
Results
Peak exogenous carbohydrate oxidation rates did not differ between GLU+FRU and GLU+SUC (1.40±0.06 vs 1.29±0.07 g/min, respectively, p=0.999), but were 46±8% higher when compared to GLU (0.96±0.06 g/min: p<0.05). In line, exogenous carbohydrate oxidation rates during the latter 120 min of exercise were 46±8% higher in GLU+FRU or GLU+SUC compared with GLU (1.19±0.12, 1.13±0.21, and 0.82±0.16 g/min, respectively, p<0.05).
Conclusion
Fructose co-ingestion (0.6 g/min) with glucose (1.2 g/min) provided either as monosaccharide or as sucrose strongly increases exogenous carbohydrate oxidation rates during prolonged exercise in trained cyclists.
Contact
jorn.trommelen@maastrichtuniversity.nl

IMPACT OF HIGH-CARBOHYDRATE AND HIGH-FAT DIET IN COMBINATION WITH NITRATE ON O2 UPTAKE KINETICS AND PERFORMANCE DURING HIGH-INTENSITY AEROBIC EXERCISE

PIATRIKOVA, E., VANHATALO, A., JONES, A.M.
UNIVERSITY OF EXETER

Introduction
The macronutrient content of the diet and nitrate supplementation have been shown to influence muscle efficiency and metabolism during exercise. However, the interaction of nitrate with diet of different macronutrient content has not been investigated. Therefore, the aim of this study was to examine the impact of a high carbohydrate (HCHO) and high fat (HFAT) diets in combination with nitrate on oxygen uptake kinetics during high intensity exercise.
Methods
In a double-blind, randomized, crossover study, 10 recreationally-active males were assigned to HCHO+NIT, HCHO+PL, HFAT+NIT and HFAT+PL treatments for 3 days each separated by 4 days washout period. Participants consumed food with an energy value of 2500 kcal a day and a macronutrient composition of 74%, 16%, 10% for HCHO diet or 9%, 19%, 72% for HFAT, from carbohydrates, protein and lipids, respectively. Participants also consumed 4 mmol of potassium nitrate or potassium chloride (as placebo) with their morning and evening meal. The exercise test started with 5 min of unloaded pedalling at 20 W followed by an abrupt increase in work rate to a fixed power output corresponding to the participant's ramp test peak power -20 W. VO2 was continuously measured and blood was collected at rest and at the end of exercise for determination of blood lactate, glucose, potassium and nitrite/nitrate concentrations.
Results
Time to exhaustion was greater in HCHO+NIT (174 ± 35s) and HCHO+PL (186 ± 39s) compared to HFAT+NIT (154± 40s) and HFAT+PL (159± 39s) (p<0.05). RER in both HCHO diets was significantly higher (~17%) at baseline and exercise (~12%) compared to HFAT diets (p<0.05). Baseline VO2 and 1 min exercise VO2 were higher in HFAT compared to HCHO diets (p<0.05). End-exercise [K+] was elevated and end-exercise blood [lactate] was lower in HFAT compared to HCHO (p<0.05). Plasma [nitrite] was significantly elevated after the consumption of nitrate in HCHO but not HFAT. There was no effect of nitrate on variables examined in this study.
Discussion
Time to exhaustion was higher in HCHO diet compared to HFAT diet as a result of impaired muscle efficiency (i.e. higher VO2 at baseline and across the transition to high-intensity exercise) that ultimately resulted in earlier attainment of VO2max. This suggests that carbohy-

drate availability is important for sustaining high-intensity aerobic exercise performance. There was no effect of potassium nitrate supplementation on the variables measured in the present study. However, lower increase in plasma nitrite perhaps suggests that nitrate-nitrite conversion was different in HFAT compared to HCHO diet.

Contact
Ep410@exeter.ac.uk

REGULATION OF EXERCISE-INDUCED IL-15 PROTEIN EXPRESSION BY ROS IN HUMAN SKELETAL MUSCLE

PÉREZ-LÓPEZ, A.1, MARTIN-RINCON, M.2, AZZINNARI, M.2, CALBET, J.A.L.2, MORALES-ALAMO, D.2

1 UNIV. OF ALCALÁ, AND 2 IUIBS, LAS PALMAS DE GRAN CANARIA, SPAIN.

Introduction

Sprint exercise elicits reactive oxygen species (ROS) production, an effect enhanced in hypoxia. Exercise-induced ROS activates AMPK, which in rodents has been shown to elicit interleukin-15 (IL-15) expression in skeletal muscle. Incubation of C2C12 cells with IL-15 increases STAT3 phosphorylation and promotes glucose uptake, fat oxidation, mitochondrial biogenesis and antioxidant enzymes expression. STAT3 activation in human skeletal muscle is associated with increased fat oxidation. Nevertheless, the influence of ROS on the expression of IL-15 and its cognate receptor alpha (IL-15Rα) in human skeletal muscle has not been tested. Therefore, the aim of the study was to determine whether during sprint exercise ROS is associated with increased activation of the IL-15/IL-15Rα axis and its downstream cascade JAK3/STAT3.

Methods

In separate days, nine volunteers performed a sprint exercise (Wingate test) in normoxia and severe acute hypoxia (inspired PO2 = 75 mmHg), 2h after the ingestion of placebo or an antioxidant cocktail (600 mg α-lipoic acid, 1000 mg vitamin C and 600 mg vitamin E) with a double-blind design. Muscle biopsies from m. vastus lateralis were obtained before, immediately, 30 and 120min after the end of the sprint. IL-15, IL-15Rα, STAT3 and carbonylated proteins (OxyBlot kit) expression were analyzed by Western blot.

Results

Mean power output and O2 consumption were 6% and 37% lower in hypoxia compared to normoxia ($p<0.05$), while performance was similar between antioxidant and placebo groups. Muscle protein carbonylation was only increased after the sprint in hypoxia, and this effect was prevented by the antioxidants. The antioxidants intake increased IL-15 protein expression (ANOVA interaction $P=0.03$), with a significant effect 120min post-sprint (0.33-fold, $p=0.017$) that was accompanied by increased STAT3 phosphorylation (2.8-fold, $p<0.01$) and STAT3p/STAT3 total ratio (5.2-fold, $p<0.001$). IL-15Rα protein expression was not significantly altered.

Discussion

Overproduction of ROS during sprint exercise has been associated with aconitase inactivation and inhibition of mitochondrial respiration, ryanodine receptor fragmentation and sarcoplasmic reticulum Ca2+ leak. Here we show that antioxidants intake before sprint exercise facilitates skeletal muscle IL-15 expression, which is necessary for the normal adaptation to exercise. Excessive ROS production during sprint exercise may blunt exercise-induced IL-15 expression. In conclusion, antioxidants permit an increase in IL-15 expression after sprint exercise coinciding with increased STAT3 phosphorylation, a known mechanism by which IL-15 promotes glucose uptake and fat oxidation.

CF INTAKE AFFECTS OXIDATIVE STRESS, ENDOTHELIAL FUNCTION AND CEREBRAL AND MUSCULAR OXYGENATION DURING EXERCISE IN HYPOXIA

DECROIX, L., LESPAGNOL, E., HEYMAN, E., MEEUSEN, R.

VRIJE UNIVERSITEIT BRUSSEL

Introduction

During exercise in hypoxia (H), O2 delivery to brain and muscle is compromised and oxidative stress is elicited. Cocoa flavanols (CF) are polyphenols with antioxidant capacities, which can also increase blood flow by stimulating endothelial function. Therefore, this study examined the effects of 7-days CF intake on markers of oxidative stress and muscle and cerebral oxygenation in response to exercise in H (3000 m, 14.3 % O2).

Methods

Fourteen male well-trained cyclists participated in this randomized, double blind, cross over study with 4 interventions: exercise in normoxia (N) or H after 7 days of CF (100 mg epicatechin) or placebo (PL) intake. Upon arrival (baseline), flow mediated dilation (FMD) was measured before the intake of the last dose. One hundred minutes later, participants performed a 20-min steady-state (SS) at 45% VO2max, followed by a 20-min time trial (TT). Prefrontal and muscular oxygenation (Tissue Saturation Index (TSI)) were measured by Near-Infrared spectroscopy. Blood samples were drawn at arrival, pre-and post-exercise for the analysis of malondialdehyde (MDA), total antioxidant capacity (TEAC) and uric acid (UA). Two and three-way RM ANOVA were used to determine differences between supplements (S) and conditions (C) in rest and during exercise (E).

Results

At baseline, FMD was significantly increased by CF (S: $F=5,59$ $p=0,042$; CF: 2.06 ± 0.85 % vs PL: 0,05 ± 1.08 %). MDA, TEAC and UA were not affected by CF at baseline and pre-exercise. The exercise-induced increases in MDA, TEAC and UA were larger in H compared to N. CF suppressed MDA formation in H and N, but did not influence TEAC nor UA (MDA: E x S: $F=7,95$ $p<0,015$; TEAC: E x C: $F= 4,83$ $p=0,05$; UA: C: $F=6,48$ $p=0,026$). At rest and during SS, H induced a decrease in prefrontal and muscular TSI. CF elevated prefrontal TSI in N and H, but had no effect on muscular TSI (prefrontal: C x E: $F=24.10$ $p<0.001$, S: $F=12.28$ $p=0.004$; muscular: C x E: $F=11.95$ $p<0.001$). During TT, H accelerated the exercise-induced decrease in prefrontal TSI (C x E: $F=10.47$ $p<0.001$), but H did not influence the exercise-induced decrease in muscular TSI (E: $F=71.65$ $p<0.001$). CF had no effect on prefrontal and muscular TSI during TT.

Conclusion

CF can reduce exercise-induced oxidative stress formation, which is elevated in H. CF can partially restore the hypoxia-induced decline in prefrontal oxygenation at rest and during low-intensity exercise in well-trained athletes. During high-intensity exercise, prefrontal and muscular oxygenation were not impacted by CF.

THE EFFECT OF CAFFEINATED COFFEE ON ANAEROBIC PERFORMANCE IN RECREATIONALY ACTIVE MALES

KARAYIGIT, R., YASLI, B.C., KARABIYIK, H., ERSOZ, G.
ANKARA UNIVERSITY

Introduction
The effect of caffeine elicits on endurance performance is well founded. However, comparatively less research has been conducted on the ergogenic potential of anaerobic performance. Additionally, It has previously been reported that caffeine is most commonly supplemented by athletes in the form of coffee and widely used among active people to enhance performance (Eric, 2016). The principal mechanism of caffeine's ergogenic effects is through its ability to act as an adenosine receptor antagonist to induce effects on both central and peripheral nervous system, to reduce pain and exertion perception, improve motor recruitment, and excitation-contraction coupling (Hodgson, 2013). Therefore, the aim of this study was to investigate effect of caffeinated coffe on anaerobic performance in recreationally active males.
Methods
Eleven recreationally active males (24,90 ± 3,61 yrs, 177,36 ± 7,55 cm, 76,35 ± 14,70 kg) are participated to study. A randomized double-blind, crossover, counter-balanced design was employed. Following familarization, participants attended three seperated sessions (48 hours apart between each sessions): Control(CON), COFFEE (COF), PLACEBO (PLA). A 30-sec Wingate test protocol was completed on a cycle ergometer (Monark 894E, Sweden) 60 min following ingestion of 3mg/kg caffeine in coffee form (0,093gr/kg) or PLA caffeine with no caffeine content (0,093gr/kg). Heart rate (HR), Rating of Perceived Exertion (RPE) were measured at resting state, immediately before and after test protocol. Performance and physiological parameters analyzed by repated measures one-way and two-way ANOVA.
Results
No significant differences were found for, peak power (PP) (p>0,740), peak power/kg (PP/kg) (p>695) and mean power (MP) (p>0,838), mean power/kg (MP/kg) (p>0,745), HR (p>0,456), RPE (p>0,600) between sessions at any time points.
Discussion
The results from the present study demonstrate caffeinated coffee ingestion does not have an ergogenic effect on PP, MP, PP/kg, MP/kg and other physiological parameters during a 30-sec all-out Wingate performance test. These performance results are consistent with some previously reported findings (Greer, 2006).
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Contact
yasli@ankara.edu.tr.

Oral presentations

OP-PM04 Genomics, proteomics and muscle molecular biology

A POLYGENIC PROFILE TO PREDICT RATE OF RECOVERY AFTER REPEATED MAXIMAL SPRINTS

BAUMERT, P., TEMPLE, S., LAKE, M., DRUST, B., STEWART, C.E., ERSKINE, R.M.
LIVERPOOL JOHN MOORES UNIVERSITY

Introduction
Insufficient recovery following exercise-induced muscle damage (EIMD) can lead to injury, and there is evidence that genetic variation may play a role. We have recently screened 63 untrained subjects for 7 genetic variations [1], which encode proteins responsible for the structural integrity of the muscle fibre, and divided them into three groups according to their polygenic profile [preferential (PG); moderate (MG); non-preferential (NPG)] (study 1). Thirteen PG showed attenuated quadriceps strength-loss and soreness following EIMD compared to 12 NPG [2]. As hamstring strains are the most common type of injury in sport and usually occur during sprinting, the aim of this new study was to investigate if our polygenic profile could predict fast and slow recovery in the hamstrings and quadriceps after multiple sprints. We hypothesised that PG would demonstrate an attenuated loss of maximal voluntary contraction torque in both quadriceps (QMVC) and hamstrings (HMVC) compared to NPG.
Methods
DNA was extracted from venous blood of another 40 non-resistance-trained young men and samples were genotyped for the same 7 gene variations as in study 1 via real time-PCR. Six PG and 5 NPG were identified and selected to take part. Participants performed 15 x 30 m maximum sprints. Before, immediately after, and 48h after the sprints, QMVC, HMVC and soreness were assessed.
Results
Strength loss and leg soreness showed a main effect of time in both muscle groups (p<0.001) and leg soreness showed an effect of group (PG/NPG) (p=0.014). There was a group x time interaction for QMVC (p=0.045). PG showed attenuated loss in QMVC change immediately post-EIMD compared to NPG (-14±11% vs. -32±23%), and faster recovery 48h post-EIMD (-5±15% vs. -33±23%). There was also a group x time interaction for HMVC (p=0.038). PG maintained HMVC (+2±16%) compared to NPG (-22±9%) post-EIMD, but both groups showed a similar strength loss 48h post-EIMD (PG: -20±22%; NPG: -29±16%).
Discussion
Repeated maximal sprints led to strength loss in both hamstring and quadriceps muscles. The quadriceps of PG recover quicker than those of NPG, thus replicating our previous findings but in a more applied context. The hamstring recovery pattern also differed according to polygenic profile but the strength loss at 48h post-EIMD was similar between polygenic groups. The various phases during sprinting, as well as between muscle differences in size/structure, may have influenced the different genetic associations with recovery patterns between muscle groups. Thus, a muscle-specific polygenic profile may be necessary to predict fast/slow recovery following repeated sprints.

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A PROSPECTIVE ASSOCIATION AND VALIDATION STUDY OF GENETIC VARIANTS AND HAMSTRING INJURY IN ELITE FOOTBALL PLAYERS

LARRUSKAIN, J.1, CELORRIO, D.2, BARRIO, I.1, ODRIOZOLA, A.1, GIL, S.M.1, NOZAL, R.2, FERNANDEZ-LOPEZ, J.R.2,3, ORTU-ZAR, I.4, LEKUE, J.A.1,4, AZNAR, J.M.2

1: UNIVERSITY OF THE BASQUE COUNTRY (UPV/EHU), 2: BAIGENE, 3: KIROLENE, 4: ATHLETIC CLUB

Introduction
Single nucleotide polymorphisms (SNPs) may contribute to the interindividual variation in musculoskeletal injury risk, [1] but no study has investigated the influence of genetic variants on hamstring injury, the most frequent injury in male football. The aim was to investigate the association of candidate SNPs with hamstring injuries in elite male football players, and to build and validate a predictive model to estimate the risk of these injuries.
Methods
107 Caucasian male football players from the Basque Country playing in Athletic Club's First, Reserves and U18 teams were prospectively followed for 6 seasons. Non contact hamstring muscle injuries and exposure time were recorded by the medical staff following the FIFA consensus statement. Players were genotyped for 37 candidate SNPs. The association of SNPs, previous injury, age and anthropometric data with 129 injuries (413 observations) was investigated in the discovery phase (2010-2015), and a multivariate Cox-frailty model [2] was created using forward selection. Hazard ratios (HR) and 95 % confidence intervals (CI) were calculated. The discriminative ability of the model was tested in the validation phase (2015-2016, 31 injuries, 98 observations) using Harrell's C index, which estimates the probability that of two random players, the player with the higher risk score will be more likely to get injured compared to the player with the lower risk score.
Results
5 SNPs were significantly associated with hamstring injury in a multivariate model, MMP3 (Matrix metalloproteinase-3) rs679620 (AA vs. GG+GA, HR=2.4, 95% CI=1.4-4.0) , TNC (Tenascin-C) rs2104772 (AA vs. AT+TT, HR=1.8, 95% CI=1.1-3.1), IL6 (Interleukin-6) rs1800795 (GG vs. GC+CC, HR=1.6, 95% CI=1.0-2.6), NOS3 (Nitric oxide synthase-3) rs1799983 (GG vs. GT+TT, HR=1.6, 95% CI=1.0-2.6) and HIF1A (Hypoxia-inducible factor-1a) rs11549465 (CC vs. CT, HR=2.2, 95% CI=1.0-4.8). Age also entered the model (≥24 vs. ≤23 years HR=2.1, 95% CI=1.3-3.4). The model showed acceptable discrimination in the discovery phase (C index=0.74), but not in the validation phase (C index=0.52).
Discussion
Genetic variants appear to be involved in the aetiology of hamstring injuries, but had no predictive ability. To overcome the limitations of the study, future research should use whole-genome screening methods and include other risk factors in multifactorial models.
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LOW CARBOHYDRATE TRAINING ACTIVATES MARKERS OF MITOPHAGY INDEPENDENT OF PROVISION OF PROTEIN LOW OR HIGH IN LEUCINE CONTENT

IMPEY, S.

LIVERPOOL JOHN MOORES

Introduction
Training with reduced carbohydrate (CHO) availability augments mitochondrial biogenesis, yet mitochondrial degradation is also essential for training adaptation (Lira et al. 2013). Low CHO training may be a potent method to mediate mitochondrial turnover given that autophagy and mitophagy are elevated by both exercise and altered energy availability (He et al. 2012). Given that athletes undertaking low CHO training generally ingest protein (in an attempt to preserve protein balance) and that amino acids stimulate mTORC1 (an inhibitor of autophagy) (Castets et al. 2013), we investigated auto- and mitophagy in response to low CHO with provision of amino acids low and high in leucine. We hypothesise that low CHO training would increase markers of auto- and mitophagy and that provision of leucine rich protein would inhibit the up-regulation of such markers.
Methods
In a repeated measures cross-over design, eight males completed 75-min non-exhaustive cycling 36 h after completion of an exercise-nutrition protocol to lower starting muscle glycogen to ~350 mmol.kg-1 DW (Impey et al. 2016). Leucine availability was manipulated by feeding 22g collagen (COL) or whey (WHEY) protein 45 min pre-exercise, 22g during exercise and 22g immediately post-exercise. CHO was consumed immediately post- and 1h post-exercise in both trials (1.2g/kg BM). Biopsies from the vastus lateralis were obtained immediately pre-, post- and 1.5h post-exercise to assess muscle glycogen, markers of mitophagy and autophagy related proteins and p70S6K1 kinase activity. Two-way RM ANOVA was used to detect changes between conditions.
Results
Exercise decreased ($p<0.001$) muscle glycogen by comparable levels from pre- to post-exercise in both trials (~350 to 150 mmol.kg-1 DW). Exercise induced comparable increases in PGC-1α (8-fold) ($p=0.003$), ATG12 (1.3-fold) ($p=0.015$) and Parkin mRNA (1.3-fold) ($p=0.037$) at 1.5h post-exercise, western blots showed similar reductions in LC3bI ($p<0.001$), II ($p=0.021$) and p62 ($p<0.001$) protein. Post-exercise feeding increased p70S6K1 activity at 1.5h post-exercise ($p=0.004$), the magnitude of which was greater ($p=0.046$) in high leucine WHEY condition versus low leucine COL (180±105; 73±42 fmol.min-1.mg-1, respectively).
Discussion
We provide novel data demonstrating acute exercise induces transient changes in markers of mitophagy and autophagy in response to exercise undertaken with reduced CHO availability. Furthermore, up-regulation of these markers is not influenced by leucine-mediated activity of mTORC1 signalling cascades.
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THE VITAMIN D RECEPTOR IS A "BIOMARKER" OF HYPERTROPHIC RESPONSES TO RESISTANCE EXERCISE AND MECHANISTICALLY REGULATES MUSCLE MASS

BASS, J.J., NAKHUDA, A., DEANE, C.S., WILKINSON, D.J., PHILLIPS, B.E., SMITH, K., ANDERSEN, D., PHILP, A., TARUM, J., KADI, F., SZEWCZYK, N.J., CLEASBY, M.E., ATHERTON, P.J.

1 UNIVERSITY OF NOTTINGHAM UK; 2 UNIVERSITY OF EXETER UK; 3 UNIVERSITY BIRMINGHAM UK; 4 ÖREBRO UNIVERSITY SWEDEN; 5 ROYAL VETERINARY COLLEGE UK

Introduciton
VitD supplementation adjuvant to resistance exercise (RE) has been shown to enhance muscle functional and hypertrophic outcomes (1). In contrast, VitD deficiency (~25% of the population) is associated with physical inactivity behaviours (2), reduced muscle mass and metabolic dysfunction (3). VitD acts through, and regulates, the expression of the ubiquitously expressed Vitamin D receptor (VDR) and it was recently reported that the expression of VDR in muscle increases in response to acute RE (4). Nonetheless, robust links between VitD status, VDR expression and muscle mass remain ill-defined.
Methods
To explore this, 37 men/women (20-75y) underwent 20-weeks of whole-body RE, with DXA scans and m.vastus lateralis muscle biopsies pre/post RET. Intriguingly, gene expression of the VDR positively correlated with the magnitude of thigh muscle hypertrophy (p=0.01, R2=0.16) with up-regulation being greatest in "high reponders" (+34±8%, P<0.05) and absent in low responders (+0±9%, N.S). In stark contrast, serum 25[OH]D status was detached from both muscle hypertrophy and VDR expression. To investigate the existence of a truly mechanistic role of VDR in relation to muscle mass, we over-expressed (VDR-OE) or knocked-down (VDR-KD) the VDR in rat hind-limbs by electroporation of cDNA or shRNA (under 2.5% isofluorane and 50mg/kg carprofen).
Results
We found that VDR-OE induced myofibre hypertrophy (+17±7%, p<0.05) and increased protein content (+57±12%, p<0.05) via increasing global protein synthesis (+69±7%,p<0.05), translational efficiency (e.g. mTOR-signalling +93%±30%, p<0.05), ribosomal biogenesis (RPL21 +78%±31%, p<0.05) and satellite cell content (+44±30%,p<0.05). In contrast VDR-KD elicited myofibre atophy (-8±2%, p<0.001) and induced autophagy-related pathways (LC3B-II +84±43%, p<0.05).
Discussion
Thus, the VDR is a "biomarker" of RE-induced hypertrophy in man, while the VDR mechanistically acts to reciprocally induce hypertrophy and limit atrophy.
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AGE-RELATED ANABOLIC RESISTANCE OF MYOFIBRILLAR PROTEIN SYNTHESIS TO MODERATE-DOSE PROTEIN INGESTION IS EXACERBATED IN OBESE INACTIVE INDIVIDUALS

SMEUNINX, B., MCKENDRY, J., WILSON, D., MARTIN, U., BREEN, L.

UNIVERSITY OF BIRMINGHAM

Introduction
Age-related muscle wasting (sarcopenia) impairs physical function and increases the risk of frailty/falls and mortality. Understanding the mechanisms behind sarcopenia is essential in the development of preventative interventions. Sarcopenia may be partly underpinned by a diminished muscle anabolic response to protein nutrition. Currently, it is unclear whether this age-related muscle 'anabolic resistance' is an inevitable part of chronological ageing, or is driven by aspects of biological ageing. Therefore, the aim of the present study was to compare postabsorptive and postprandial myofibrillar protein synthesis (MyoPS) rates between lean young, lean older and obese older individuals.
Methods
Ten old lean (OL: 71.7 ± 6 yrs) and 7 old obese individuals (OO: 69.1 ± 2 yrs) were recruited for comparison against 18 young lean controls (YL: 25.5 ± 4 yrs). Preliminary assessments of body composition, insulin resistance and inflammation were determined, as were 4-day dietary intake and physical activity levels. Thereafter, skeletal muscle biopsies were obtained prior to and 4h after ingestion of 15g of milk protein isolate for assessment of MyoPS via primed-continuous infusion of L-[ring-13C6]-phenylalanine. Muscle biopsies were also analyzed for fibre-type characteristics and intramyocellular lipid (IMCL) content.
Results
Body fat mass, leg fat mass, visceral adiposity, IL-6 concentration and insulin resistance (HOMA-IR) were greater in OO compared with YL and OL. Relative fat-free mass was lower in OO compared with YL and OL ($p < 0.01$). Average daily step-count was lower in OO (5399 ± 2079) compared with YL (11870 ± 3905) and OL (11102 ± 3273; $p < 0.01$). Type I and II fibre CSA was significantly lower in OL and OO compared with YL ($p < 0.01$). Percentage type II muscle fibre area covered by IMCL was significantly elevated in OO compared with YL and OL ($p < 0.01$). Postabsorptive MyoPS rates were similar between groups. Postprandial MyoPS rate increased above postabsorptive values by 81% in YL (0.049 ± 0.003%h-1) and 37 % in OL (0.045 ± 0.003%h-1), respectively ($p < 0.01$), with no apparent increase in OO (9%; $p = 0.4$). The postprandial MyoPS response correlated positively with step-count ($r2 = 0.26$, $p = 0.036$) and inversely with leg fat mass ($r2 = 0.4$, $p < 0.01$) in OO and OL.
Discussion
The MyoPS response to a moderate-dose protein ingestion is significantly diminished in OO compared with YL and OL, which may partially be attributed to lower physical activity levels and excess adiposity. We conclude that physical activity and healthy body composition are pivotal in maintaining robust skeletal muscle anabolic sensitivity and mass in old age.

THE EFFECTS OF WHOLE BODY VIBRATION AND IMMOBILIZATION ON PROTEIN SYNTHESIS AND DEGRADATION PATHWAYS

AKIN, S., DONMEZ, G., OZDEMIR, M., NAITO, H., ICHINOSEKI-SEKINE, N., POWERS, SK., DEMIREL, HA.
HACETTEPE UNIVERSITY

Introduction
Disuse such as immobilization, denervation and hindlimb suspension result in skeletal muscle atrophy. Although atrophy is an important clinical problem, there are no known therapeutic interventions. Recently, there is a growing interest on Whole Body Vibration (WBV) which has shown to increase muscle mass, strength, and balance. The molecular mechanisms of the effect of WBV on skeletal muscle are under investigation. This study was designed to elucidate the effects of immobilization, remobilization, and WBT on signaling pathways involved in muscle atrophy and hypertrophy.
Methods
Four months old female Wistar Albino rats randomly divided into five groups (n=6 each group): Control (C), two weeks of immobilization (I), immobilization followed by one week of remobilization (IR), immobilization followed by one week of remobilization and WBV (IRV) one week of WBV (WBV). Bilateral casting was done at plantar flexion position. WBV group underwent one week of vibration protocol at 45Hz and 3mm amplitude reaching 20min of daily duration at day 4th. Following experimental procedure, soleus muscles were isolated. Gene expressions of MuRF1, MAFbx, FoxO1, FoxO3a, myostatin, Akt1, mTOR were evaluated by using RTPCR. Protein levels of MuRF1, MAFbx, p-FoxO3a, p-Akt, p-4EBP1 were analyzed by immunoblotting. Soleus/body weight ratio decreased in group I compare to group C. MuRF1 gene expressions of groups of I, IR and IRV significantly lower than that of group C ($p<0.05$).
Results
There were no significant differences among groups in terms of FoxO1, FoxO3a, MAFbx and myostatin gene expression ($p>0.05$). Protein levels of p-FoxO3a and p-4EBP1 were significantly lower in groups I, IR and IRV compare to group C ($p<0.05$). In addition, p-FoxO3a levels in group I was lower than that of group IRV ($p<0.05$) and the levels of p-4EBP1 was lower in group I compare to groups IR, IRV and WBV ($p<0.05$). mTOR and p-Akt1 protein levels were lower in group I compare to others ($p<0.05$). Both MAFbx and MuRF1 levels were higher in group I compare to groups C and IRV ($p<0.05$).
Discussion
These findings show that two weeks of immobilization resulted in decreases in the protein expressions of the molecules involved in protein synthesis an increase in the protein levels of the molecules involved in protein degradation. It seems that WBV with the duration, frequency, and amplitude used in this study has limited effect on signal transduction pathways involved in both protein synthesis and degradation since only the regulation of p-4EBP1, MuRF1 and MAFbx were affected in IRV group.

Oral presentations

OP-PM10 Health and fitness in children and adolescents 2

GIRLS ARE LESS PHYSICALLY ACTIVE DURING SCHOOL HOURS BUT MORE ACTIVE AFTER SCHOOL COMPARED TO BOYS

MOOSES, K., KULL, M.
UNIVERSITY OF TARTU

Introduction
The evidence suggests that both moderate and vigorous physical activity (MVPA) and sedentary time (SED) are independently associated with health outcomes (Ekelund et al., 2012). Although daily physical activity (PA) of boys is higher than girls' (Nettlefold et al., 2011), little is known about gender differences in different day segments. Therefore, the aim of this study was to compare MVPA and SED of boys and girls in different school day segments.
Methods
The PA of students from first (age 7.9 ± 0.6) and second (age 11.0 ± 0.7) school stage was measured with Actigraph GT3x for one school week. According to the measured height and body mass, the body mass index (BMI) was calculated. The inclusion criteria for analysis was at least 10 hours of recorded PA data per day for a minimum of four school days (n=472). Minutes of MVPA and SED were calculated using Evenson cut-off points for children (Evenson et al., 2008). Separate three level linear mixed models for SED and MVPA for each day segment were calculated to analyse gender differences. All models were controlled for BMI, school stage, time spent in the segment investigated and whole day MVPA. The statistical significance of the model estimates was evaluated using 95% confidence intervals (CI).
Results
On school days 30.5% of boys and 17.5% of girls met the PA recommendations (a minimum of 60 min of MVPA) at least on four school days. There were no gender differences in MVPA or SED in before school segment. During school hours girls spent less time in MVPA (-3.6, 95% CI -4.5– -2.6) and more as SED (10.4, 7.3–13.5) compared to boys. During recess and class time girls had less MVPA minutes (-1.8, -2.2– -1.4 and -0.9, -1.4– -0.4, respectively) and more SED (3.1, 2.2–3.9 and 6.4, 3.9–8.9, respectively) compared to boys. After school girls spent 3.6 (2.5–4.7) minutes more in MVPA and 13.4 (-18.5– -8.4) minutes less as SED compared to boys.
Discussion
Lower PA of girls during school hours compared to boys is in accordance with previous studies (Nettlefold et al., 2011; Fairclough et al., 2012). However, higher PA of after school compared to boys contradicts previous findings where no difference was observed (Fairclough et al., 2012). Therefore, our results highlight the need for gender specific interventions in school.
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Contact
Kerli. Mooses@ut.ee

THE DASH-STUDY: DISEASE, ACTIVITY AND SCHOOLCHILDREN'S HEALTH IN MARGINALIZED SCHOOLS IN PORT ELIZABETH, SOUTH AFRICA: SELECTED BASELINE RESULTS

PÜHSE, U., MÜLLER, I., GALL, S., UTZINGER, J., WALTER, CH.

UNIVERSITY OF BASEL

Introduction
As traditional lifestyle and diets change with social and economic development, deprived communities in low- and middle-income countries increasingly face a double burden of communicable and non-communicable diseases. We studied the relationship between physical fitness and infections with soil-transmitted helminths (STHs) and cognitive performance among schoolchildren in Port Elizabeth, South Africa.
Methods
We conducted a cross-sectional survey among approximately 1000 children, aged 9 to 12 years, from eight primary schools in socioeconomically disadvantaged neighbourhoods of Port Elizabeth. Physical fitness was determined using tests of the Eurofit fitness test battery. Children's school grades were obtained and the d2 test of attention was used to determine attention capacity as a measurement for cognitive performance. Stool samples were analysed with the Kato-Katz thick smear technique to diagnose STHs. Haemoglobin (Hb) levels were assessed and anthropometric indicators determined.
Results
In two schools, high STH prevalences were found (Ascaris lumbricoides 60 and 72%; Trichuris trichiura 65% each). For boys and girls co-infected with A. lumbricoides and T. trichiura (n=155) the maximal oxygen uptake (VO2 max) was estimated to be 50.1 and 47.2 ml kg-1 min-1, compared to 51.5 and 47.4 ml kg-1 min-1 for their non-infected peers (n=278), respectively. Children with helminth infection, irrespective of age or sex, had a lower concentration performance score (43.3 vs. 59.5), a higher percentage of errors (20.9 vs. 14.9) and poorer school grades (3.2 vs. 4.4). Similar results were found when comparing stunted children and normal children. Overall, a significant ($p<0.05$) positive association was found between selective attention and cardiorespiratory fitness and a negative association between selective attention and helminth infection. On average, children without helminth infections had greater body mass ($p=0.011$), height ($p=0.009$) and a higher body mass index ($p=0.024$) and were less often stunted ($p=0.006$), but not significantly less wasted compared to their peers with a single or dual species infection.
Discussion
Intestinal parasite infections appear to have a small but significant negative effect on the physical fitness of infected children, as expressed by their maximal oxygen uptake. Stunting stemming from malnutrition as well as soil-transmitted helminth infections seem to hamper children's cognitive performance and their selective attention. We observed a clear impact on anthropometric indicators.
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CORRELATES OF PRESCHOOLS CHILDREN'S OBJECTIVELY MEASURED PHYSICAL ACTIVITY, PHYSICAL FITNESS LEVELS AND MORPHOLOGICAL DEVELOPMENT OF MUSCLE: A CROSS-SECTIONAL STUDY

PENGYU, D., HAYAO, O., TOSHIHARU, N., DAJIANG, L., SHUICHI, M., HISASHI, N.

JUNTENDO UNIVERSITY

Introduction
Physical inactivity and poor physical fitness in childhood is associated with many preventable diseases in adulthood, and represents a serious current and future public health problem. Moreover, physical fitness (PF) was closely related to the function and quantitative development of muscle to affects the force exerted and power. The purpose of this study was to determine the determine the relationship in preschool children's between physical activity (PA), PF levels and muscle thickness (MT), in order to clarify the effects of morphological development of muscle as well as differences in these effect due to weight status.
Methods
Participants comprised 123 children in 3-5 years (65 boys, 58 girls) in good health attending a preschool school in the city of Shanghai, China. The children consisted of normal-weight (NW), overweight/obese (OW/OB) children who determined by BMI according to Working Group for Obesity in China cut offs. MTs were using B-mode ultrasonography: the anterior aspect of upperam and forearm, abdomen, and the anterior and posterior aspects of the thigh and lower leg. The PA was quantified by on axis-accelerometer (Lifercorder GS) measuring weekly steps and Moderate-to-Vigorous PA (≧3METs, MVPA) for 7days. The PF levels was evaluated based on 5 tests: 25m run, standing long jump, grip strength, sit and reach, and body support duration.
Results
Three-way ANOVA (gender × weight status × age) revealed that the main weight status effect was significant in WT in both boys and girls ($p<0.05$), whereas, the OW/OB group had no significantly lower PA and PF levels than the NW group on both boys and girls. For the PA, time in PA was positively associated with the anterior aspects of the thigh in boys ($p<0.05$), and the posterior aspects of the lower leg in girls ($p<0.05$), respectively. For the PF levels, grip strength was positively associated with each MT in girls only ($p<0.05$). Standing long jump was positively associated with MT of forearm, abdomen, the anterior aspects of the thigh, and the posterior aspects of the lower leg in both boys and girls ($p<0.05$).
Discussion
Our finding suggested no significant difference in the PA and PF levels between the NW and OW/OB children in both boys and girls in 3-5 years preschool children. We also found a significant associated between MTs and PA and PF levels. These findings suggest that greater MTs were associated with more PA and better PF levels in preschool children, independent of weight status.
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Contact
tohouu@yahoo.co.jp

3D PRINTING AS A TOOL TO ENHANCE CHILDREN'S UNDERSTANDING OF PHYSICAL ACTIVITY LEVELS

MACKINTOSH, K.A.1, CROSSLEY, S.G.M.1, ESLAMBOLCHILAR, P.2, KNOWLES, Z.3, MCNARRY, M.A.1

1APPLIED SPORTS, TECHNOLOGY, EXERCISE AND MEDICINE RESEARCH CENTRE, SWANSEA UNIVERSITY, WALES, UK; 2COMPUTER SCIENCE DEPARTMENT, SWANSEA UNIVERSITY, WALES, UK; 3 PHYSICAL ACTIVITY EXCHANGE, SCHOOL OF

Introduction
Current UK physical activity (PA) guidelines recommend that children aged 5-18 years engage in at least 60 minutes moderate-to-vigorous PA daily. However, the majority of children fail to meet these guidelines, with a frequently cited barrier being that the guidelines are difficult to measure, interpret and apply by children. 3D printing enables the creation of a novel, tangible output to conceptualise children's physical activity levels (PAL). The purpose of this study was therefore to investigate the efficacy of 3D PA models in enhancing children's understanding of physical activity levels and intensities and as a motivational tool.
Methods
Thirty-nine primary school (22 boys; 7.9±0.3 years) and 60 secondary school-children (39 boys; 13.8±0.3 years), participated in a three-month fading intervention in which participants were given 3D printed models of their previous week's PA. Following receipt of their models, each participant completed regular, short semi-structured interviews to assess their understanding of PAL, intensities and motivation. Data were transcribed verbatim, analysed using the Youth Physical Activity Promotion Model as a thematic framework, and then inductively to enable emergent themes to be further explored. Pen profiles were constructed representing analysis outcomes via a diagram of key emergent themes.
Results
Analyses revealed enthusiasm for the concept of visualising PA through a tangible object. Participants reported that the models improved their understanding of PA and awareness of the recommended levels. Although primary school children initially struggled to differentiate between intensities, this significantly improved over the course of intervention. Furthermore, participants highlighted the utility of such models as a motivational tool to promote PA through goal-setting.
Discussion
Results suggest that 3D printing may offer a unique strategy for the promotion of PA in children. Future studies should consider the novelty effect of such models and scalability of interventions aimed to promote engagement in PA through 3D printing. Furthermore, whether this strategy is better aligned as an educational rather than motivational tool should be explored.

TESTING THE MOTOR PROFICIENCY BARRIER HYPOTHESIS FOR PHYSICAL ACTIVITY AND WEIGHT STATUS

LOPES, V., LOPES, L., SANTOS, R., STODDEN, D.F., RODRIGUES, L.P.

POLYTECHNIC INSTITUTE OF BRAGANCA

Introduction
Recent research has shown that motor competence (MC) is associated with habitual physical activity (PA) and a healthy weight during childhood (Robinson et al., 2015). According to the Stodden et al. (2008) developmental model, obesity trajectories may be triggered by the cumulative effects of low MC, PA, physical fitness, and perceived MC across childhood. The purpose of this research was to test a motor competence (MC) proficiency barrier (PB), below which children would not achieve enough physical activity (PA) to be healthy.
Methods
Two studies were carried out. In study 1, using a cross-sectional sample (n=734; 353 girls) of 10-year-old-children, cut-off values in body coordination test for children (KTK) were identified with received operations characteristics curve analysis, as MC values that significantly separate overweight/obese from normal weight and sedentary from non-sedentary children. In study 2 a short-term longitudinal data sample (n=217; 118 girls) was used. At baseline (12.9±0.4 years old) the cut-off values from study 1 were used to define two groups (high and low MC). Changes in weight status and PA were investigated at follow-up (14.6±0.3 years old). 2 X 2 Chi-square tests were conducted to test the independence of low and high MC on weight status, moderate-to-vigorous PA (MVPA), and sedentary time (ST). Odds of being obese and sedentary according MC cut-off values at baseline were calculated.
Results
The MC cut-off of 79 and 75 for girls and boys respectively, were used as PB. In girls, PB predicted significant different classifications on weight status, and combined weight status and MVPA, at both baseline and follow-up. In boys, PB predicted significant different classifications on combined weight status and MVPA at baseline. Independent of sex, being below PB at baseline returned a 2.78 higher probability of being overweight.
Discussion
The cut-off values of MC tested as PB clearly separate overweight from no overweight and active from less active girls, but it does not work so well in in boys. However, independent of child sex the probability of being overweight two years in the future, when below the hypothesized PB at baseline was significantly higher than when above the PB. Thus, the results of the present study shown that a MC proficiency barrier for weight status and PA may exist. This thematic need to be examined by long-term longitudinal studies.
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Contact
vplopes@ipb.pt

THE EFFECTIVENESS OF A SCHOOL-BASED MOTOR DEVELOPMENT INTERVENTION ON FUNDAMENTAL MOVEMENT SKILL PROFICIENCY AND MARKERS OF HEALTH AMONG IRISH CHILDREN

BOLGER, L.A., BOLGER, L.E., O' NEILL, C., COUGHLAN, E., BURNS, C.

CORK INSTITUTE OF TECHNOLOGY

Introduction
Fundamental movement skill (FMS) proficiency among children worldwide is low. There is a paucity of related research in existence among European children, with no recorded data in an Irish context. Health data of Irish children has reported that 25% are unfit, over-

weight/obese, and have high blood pressure (Woods et al 2010). The purpose of the current study was to assess the effectiveness of a motor development intervention on FMS proficiency and markers of health among Irish children.
Methods
Children (N=446, mean age: 8.5±2.07 years, range: 5.2-12.2 years) from 2 intervention and 1 control school were selected to participate in the study. FMS proficiency was evaluated using the Test of Gross Motor Development-2 (Ulrich 2000), with 6 locomotor (LOCO) and 6 object-control (OC) skills assessed. Selected markers of health were BMI, 550m run time and physical activity (PA) measured via accelerometry. The intervention was delivered across one academic year and consisted of 2 X 25 minute FMS-specific sessions per week.
Results
The intervention (INT) group significantly increased TOTAL FMS (67.5±7.21 to 74.5±5.45, $p<0.01$), LOCO (40.8±3.97 to 44.2±3.15, $p<0.01$) and OC scores (26.9±4.98 to 30.3±3.85, $p<0.01$). In contrast, the control (CON) group showed significant decreases in TOTAL FMS (68.8 ± 6.21 to 67.1±7.12, $p<0.01$) and LOCO scores (40.8±3.80 to 39.8±3.95, $p<0.01$), with no difference evident in OC ($p>0.05$). The INT group significantly improved in 10 of the 12 FMS tests, while the CON group improved in only 3 ($p<0.05$). Markers of health analysis found a significant decrease in the BMI of the INT group (mean change: -0.6±1.46 kg/m2, $p<0.01$), while a significant increase in BMI was observed in the CON group (mean change: 0.2±0.68, $p<0.05$). There were significant improvements in 550m run times among both the INT and CON groups (mean change: INT-19.6±22.61 secs v CON -12.5±21.26 secs, $p<0.05$ for both), with a significantly greater improvement in the INT group ($p<0.01$). Both groups significantly increased total PA (mean change: INT 21.7± 38.82 mins v CON 41.9±48.48 mins, ($p<0.05$), with no difference between the mean changes ($p>0.05$).
Discussion
The implementation of a school-based motor development intervention has the potential to improve FMS proficiency and markers of health among Irish children.
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Oral presentations

OP-PM11 Coaching: Performance

IMPLEMENTATION OF A MULTI-DIMENSIONAL MONITORING SYSTEM TO IDENTIFY PERFORMANCE DECREMENTS IN HIGHLY TRAINED SWIMMERS

CROWCROFT, S., SLATTERY, K., MCCLEAVE, E., COUTTS, A.J.
UNIVERSITY OF TECHNOLOGY SYDNEY

Introduction
Many athlete monitoring tools fluctuate in response to training load (TL). However, little evidence supports the use of any single monitoring variable to recognise performance changes [1]. Rather, it is recommended that changes in physiological and perceptual state be contextualised in response to TL and training goals. Currently, few studies have assessed a multi-dimensional monitoring system to distinguish how athletes are tolerating training demands. Therefore, the purpose of this study is to assess the diagnostic accuracy of a psycho-physiological monitoring system to identify performance decrements in highly trained swimmers.
Methods
Nine highly trained swimmers (7 males, 2 females, age: 21.6 ± 2.0 y) recorded sleep quality, perceived fatigue, total quality recovery (TQR), heart rate variability (R-R interval and Ln rMSSD) and TL measures (training distance, total TL) over a 9-month period. To account for individual variations, values were analysed as a rolling 7-d average and calculated as an effect size change from baseline. All race results (N= 126) were then classified as a dichotomous outcome (0= No change, 1= performance decrement (greater than 0.3 x individual athlete CV)). Variables were analysed using binary logistic regression to determine a predictive equation and assess probability of a performance decrement. Probability was then analysed using Receiver Operating Characteristic curve to assess the models diagnostic accuracy, area under the curve (AUC), sensitivity and specificity.
Results
Of 115 races, 24 resulted in a performance decrease. Logistic regression models including 28-d average distance, R-R interval and TQR had the highest Nagelkerke R2 value (R2=0.33). From this model the optimal cut-off value of probability to identify performance decrements was <82% (AUC- 0.80 (95% CI; 0.72-0.89), Youden Index- 0.61, Sensitivity-96%, Specificity-65%).
Discussion
The main findings revealed good diagnostic accuracy of the psycho-biological athlete monitoring system to assess performance decrements. Indeed, combining physiological (R-R interval), perceptual (TQR) and TL (28-d average distance) measures have previously been supported by overreaching studies that have reported the need to contextualise changes in physiological measures with TL and the athlete's perceived training tolerance [2]. Collectively, these findings provide evidence for the use of a multi-dimensional monitoring system to identify performance decrements in highly trained swimmers.
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COACHES' PHILOSOPHIES ON THE USE OF STRENGTH TRAINING TO ENHANCE ELITE SPORTS PERFORMANCE

BURNIE, L., BARRATT, P.R., DAVIDS, K., STONE, J., WORSFOLD, P., WHEAT, J.S.
SHEFFIELD HALLAM UNIVERSITY

Introduction
Coaches of sports requiring maximal effort over a short period of time (<60 s), such as track sprint cycling, sprint kayaking, and sprint running often consider strength training (repetitive muscle actions against high loads) to be a fundamental aspect of an athletes training

programme. Despite the common prescription of strength training in elite sport, empirical evidence shows that transfer to sports performance varies (Young, 2006). Therefore, the aim of this study was to explore elite coaches' philosophies regarding strength training and the range of factors which they believe affect the transfer of strength training to sports performance.
Methods
Thirteen world class coaches and athletes from track cycling, BMX, sprint kayaking, rowing and athletics sprinting were interviewed using an open-ended, semi-structured approach. Participants were asked about their coaching philosophies, design of athlete training programmes, strength training and its transfer to sports performance. A thematic analysis was conducted. Data trustworthiness was enhanced by methods of member checking and analyst triangulation.
Results and Discussion
Coaches believed that task-specific strength is essential for sports performance. They reported that non-specific strength training ("traditional" gym-based strength exercises that are not specific to the sport movement) is important for increasing athletes' muscle size and strength. This is typically used in conjunction with resisted sport movement training (for example, increased resistance running, pedalling or rowing), believed to achieve an effective transfer of enhanced muscle strength to sports performance. Coaches described the transfer process as complex, with factors associated with fatigue and coordination having particular significance. The importance of coordination is supported by the theoretical model that demonstrates increases in muscle strength from strength training may need to be accompanied with a change in inter-muscular coordination to improve sport performance (Bobbert & Van Soest, 1994).The idea that each athlete needs to adapt intermuscular coordination in response to a change in his/her unique set of "organism constraints" (e.g. muscle strength) in an individualised way is well described by the theory of ecological dynamics and Newell's model of constraints (Newell, 1986).
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ENDURANCE PERFORMANCE INDICATORS ARE INFLUENCED BY STRESS AND RECOVERY

OTTER, R.T.A.1,2, BRINK, M.B.1,2, LEMMINK, K.A.P.M.1,2

1: HANZE UNIVERSITY OF APPLIED SCIENCES (GRONINGEN, THE NETHERLANDS), 2: UNIVERSITY OF GRONINGEN, UMCG, (GRONINGEN, THE NETHERLANDS)

Introduction
Endurance athletes seek for the optimal balance in stress and recovery so that they can perform at their best. Stress and recovery of athletes can be viewed from a physical and psychosocial perspective (Kentta & Hassmen, 1998). Most studies focused on physical stress and recovery during and after training. However, it is still largely unknown how psychosocial stress and recovery influence performance indicators. Therefore, the aim of this study was to investigate how psychosocial stress and recovery influence endurance performance indicators.
Methods
Psychosocial stress, recovery and performance indicators of 115 runners, cyclists, rowers, ice-skaters and triathletes were monitored over 2 years. All athletes kept a daily training log, filled out a weekly or 3-weekly stress and recovery questionnaire (RESTQ-sport) (Nederhof et al., 2008) and performed each 6 to 7 weeks submaximal performance tests. Unplanned events were also captured in the training log by remarks. The runners in the study all stated that they experienced the same unplanned negative life event (NLE). The analyses of these data were twofold. First, the relationship between psychosocial stress and recovery and performance indicators over 1 year was determined for female athletes (n=20; age, 27±8; height, 172±5cm; weight 62±5kg; VO2max, 50.3±4.6ml/kg/min) (Otter1 et al, 2016). For this purpose, data was analyzed with a multilevel approach. Second, the influence of the NLE on stress, recovery and performance parameters was analyzed for the runners (n=16; age, 23±4; height, 180±5cm; weight 65±7kg; VO2max, 60.9±5.9ml/kg/min)). For this purpose, the data was analyzed with ANOVA's and T-tests (Otter2 et al, 2016).
Results
Multilevel analyses revealed that an increase in general stress and a decrease in sport specific recovery are associated to impaired performance indicators (i.e. submaximal power output and heart rate recovery) of female athletes. Furthermore, a negative life event disturbs psychosocial stress and recovery of runners over a period of 2 weeks and it impairs running economy by 3.5%.
Conclusion
These findings indicate that psychosocial stress and recovery play a role in performance changes of endurance athletes. Athletes and coaches could benefit from monitoring psychosocial factors to adapt training programs in each individual situation.
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Contact
t.a.otter@pl.hanze.nl

FROM TALENT TO ELITE BY DEVELOPING AN APPROPRIATE PACING BEHAVIOUR IN JUNIOR SPEED SKATING.

STOTER, I.K.1, WIERSMA, R.1, VISSCHER, C.1, HETTINGA, F.J.2, ELFERINK-GEMSER, M.T.1

1: UMCG, RUG (GRONINGEN, NETHERLANDS), 2: UNIVERSITY OF ESSEX (COLCHESTER, UK)

Introduction
In many individual time trial sports like speed skating, an optimal energy distribution, or pacing, is essential for successful performance (Foster et al., 1993). In 1500m speed skating the optimal pacing behavior is generally a fast start, followed by a decrease in velocity over the race. However, starting too fast during a 1500m in speed skating appears to deteriorate performance (Hettinga et al., 2011; Stoter et al., 2016). The present study is the first to provide insight in the development of pacing behavior in junior speed skaters and analyses possible differences between elite, sub-elite, and non-elite juniors.
Methods

1500m season best times (SBT) and corresponding pacing behaviour were obtained longitudinally for 104 Dutch male speed skaters at age 13–14(U15), 15–16(U17), and 17–18(U19) years. Based on their U19 SBT, skaters were divided into elite (n=17), sub-elite (n=64), and non-elite (n=23) groups. Pacing behaviour was analysed using the 0-300m, 300-700m, 700-1100m and 1100-1500m times, expressed as a percentage of final time. Mixed analyses of variance were used for statistical analyses.
Results
With age, pacing behaviour generally developed towards a slower 0-300m and 1100-1500m and a faster mid-section relative to final time. While being faster on all sections, the elite were relatively slower on 0-300m (22.1±0.27%) than the sub-elite and non-elite (21.5±0.44%) ($p<0.01$), but relatively faster on 300-700m (24.6±0.30%) than the non-elite (24.9±0.58%) ($p=0.002$). On 700-1100m, the elite and sub-elite (26.2±0.25%) were relatively faster than the non-elite (26.5±0.41%) ($p=0.008$). Differences in the development of pacing behaviour were found from U17-U19 with relative 700-1100m times decreasing for the elite and sub-elite (26.2±0.31% to 26.1±0.27%), but increasing for the non-elite (26.3±0.29% to 26.5±0.41%) ($p=0.014$).
Discussion
Maintaining high speed into 700-1100m, accompanied by a relatively slower start, appears crucial for high performance on the 1500m speed skating. Generally, junior speed skaters develop towards this profile, with a more pronounced development towards a relative faster 700-1100m from U17-U19 for elite junior speed skaters. The results of the present study show the importance of developing an appropriate pacing strategy in order to become an elite speed skater in the future.
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CHANGES IN SUBMAXIMAL PERFORMANCE PARAMETERS AFTER AN ULTRA-MARATHON; PRACTICAL APPLICATIONS TO MONITOR OVERREACHING

LAMBERTS, R.P.1,2, SIEGL, A.1,3, KÖSEL, E.1,4, TAM, N.1, KOSCHNICK, S.1,3, LANGERAK, N.G.5, SKORSKI, S.3, MEYER, T.3
1 DIV. EXERC. SCI. & SPORTS MED.; 2 DIV. ORTH. SURG. & INST. OF SPORT AND EXERC. MED.; 3 INST. SPORT AND PREV. MED.; 4 BIOM. IN SPORTS; 5 DIV. NEUROSURG.

Introduction
The regular monitoring of athletes is important to fine-tune training and detect early symptoms of overreaching (1-4). Therefore, the aim of this study was to determine if a non-invasive submaximal running test could reflect a state of overreaching.
Methods
Fourteen trained runners completed a non-invasive Lamberts Submaximal Running Test (LSRT), one week before and two days after finishing an ultra-marathon. In addition, delayed onset of muscle soreness and the daily analysis of life demands of athlete's questionnaire were also captured.
Results
After the ultra-marathon, submaximal heart rate was lower running at 70% (-3 beats) and 85% of peak treadmill running speed ($p<0.01$). Ratings of perceived exertion were higher at 60% (2 units) and 85% (1 unit) of peak treadmill running speed, while 60-second heart rate recovery was significantly faster (7 beats ($p<0.001$)). Delayed Onset of Muscle Soreness scores and the number of symptoms of stress (Daily Analysis of Life Demands of Athletes) were also higher after the ultra-marathon ($p<0.01$).
Discussion
The current study shows that the LSRT can reflect early symptoms of overreaching. Symptoms of overarching were characterised by lower submaximal heart rates at the same running speeds, increased ratings of perceived exertion and a faster heart rate recovery. As these responses are counter-intuitive and without RPE information might be interpreted as a positive response instead of reflecting a state of fatigue/ overreaching, they have important practical implications for coaches and trainers.
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Oral presentations

OP-BN03 Biomechanics: Coordination and running

CHALLENGING LOCOMOTION: STABILITY AND MODULAR ORGANIZATION IN PERTURBED RUNNING

EKIZOS, A.1, SANTUZ, A.1, ECKARDT, N.2, KIBELE, A.2, ARAMPATZIS, A.1
1:HU (BERLIN, GERMANY), 2:KU (KASSEL, GERMANY)

Introduction
Irregular non-steady terrain conditions provide a unique opportunity to investigate how the central nervous system interacts with the muscles in response to challenging locomotor tasks. Humans reduce the complexity of movement diversity by combining a lower number of basic muscle activation patterns called muscle synergies to cope with a specific task (Bizzi et al., 2008). There is evidence that muscle synergies are of neural origin and follow a modular organization (Dominici et al., 2011). The purpose of the current study was to investigate the dynamic stability and the modular organization of motor control during running on uneven surface, to gain insight into the neurophysiological factors underlying perturbed human locomotion. We hypothesized a decreased stability and an altered spatiotemporal structure of the motor output but similar number of muscle synergies in perturbed running.
Methods
Eighteen young healthy participants (7 female; 24±3 years) ran on an even and an uneven treadmill at fixed speeds (female:2.0 m/s; male:2.2 m/s). Dynamic stability during running was assessed through the calculation of the largest Lyapunov exponent on four markers on the spine. Muscle synergies (motor primitives and motor modules) were extracted through non-negative matrix factorization of the

EMG signals of thirteen muscles. To evaluate the basic activation patterns we investigated the full width at half maximum (FWHM) of the motor primitives.
Results
Lyapunov exponents increased by 4.9% (p=0.001) indicating worse stability on the uneven surface. Four synergies were sufficient to describe the motor task in both conditions. Motor primitives showed significantly increased FWHM on the uneven surface in synergies 1 (7.5%), 2 (10.3%) and 3 (24.4%). Motor modules significantly changed only in synergy 3 (p=0.008).
Discussion
We found a similar modular structure of the motor output (i.e. four synergies) during running on both even and uneven surfaces despite an increased instability in the perturbed condition. The broader basic activation patterns in perturbed running indicate less precise timing and duration in the motor output. The reason for the widening of the motor primitives in synergies 1,2 and 3 may be related to the increased instability during the perturbed running. We argue that the widening of the basic activation patterns in perturbed running might increase the system's robustness in order to deal with the consequences of the induced perturbations.
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Contact
antonis.ekizos@hu-berlin.de

THE EFFECTS OF SHANK INERTIA MASS MANIPULATION ON TECHNIQUE OF ELITE SPRINTER AT MAXIMUM VELOCITY

ZHANG, C.1, LIU, Y.1, YU, B.2

1: SHANGHAI UNIVERSITY OF SPORT (SHANGHAI, CHINA), 2: UNC (CHAPEL HILL, USA)

Introduction
Developing maximal speed represents a competitive advantage across most land based sports. The resisted training is an effective way to develop athletes' speed (Hrysomallis, 2012). Loading on lower extremity did not disrupt performance (Bennett et al., 2009).But the decreasing of velocity companion with change of joint moment may induce injury in long time training was not reported. Therefore, the affection of segment load training on technique need further confirm. The purpose of this study is to examine the affection of shank load training on technique of sprinter at maximum velocity.
Methods
16 elite male sprinters sprinted randomly under two conditions: without load (0%) and with load (15% of the shank weight), started 40m away from the collection volume. 52 markers trajectories and GRF were collected using a motion analysis system (12 cameras) and 3 force plates. Linear regression analyses with category variable were performed to determine effects of speed and loading condition on lower extremity kinematics and kinetics. The full regression model for each analysis was Y = A0 + A1X1+ A2X2+ A3X1X2, where X1 was speed; X2 was a category variable representing loading.
Results
The sprinting speed was decreased with 15% load compared to 0% load ($p = 0.001$). GRF, ankle and knee ROM (range of motion), ankle and knee joint moment at landing and takeoff, hip joint moment at landing were not affected by speed and loading. Stride length (SL) and stride frequency (SF) were affected by speed ($R2 = 0.276, 0.208$; $p = 0.001, 0.005$). Hip ROM at landing was increased by 0.5° with 15% load ($R2 = 0.113$; $p = 0.045$). Hip moment at takeoff (HMOF) was affected by speed ($R2 = 0.107$; $p = 0.05$).
Discussion
Both between group difference and within loading condition difference of SL and SF might due to the change of relative strength. Bennett et al. (2009) found no difference in SL and SF in 10% load compared to 0% load which is inconsistent with our findings. This might be due to difference in loading conditions between two studies. The HMOF decreased with the decreasing of speed at takeoff, the hip joint is a primary generator of kinetic energy (Bezodis et al., 2008). Sprinters with less hip strength generated less kinetic energy. Although speed was decreased with 15% load, ROM and moment of lower extremity joint remained similar to 0% load, which means 15% load did not significantly alter the sprinting techniques of elite sprinters.
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Contact
gracejoyzc@163.com

ADAPTATIONS IN FOOT-GROUND INTERACTIONS DURING A PROGRESSIVE 12-WEEK RUNNING INTERVENTION IN FOOTWEAR WITH REDUCED CUSHIONING

COETZEE, D.

UNIVERSITY OF CAPE TOWN

Introduction
Running is one of the most widely practiced recreational activities due to its simplicity and accessibility. Although popular, it is associated with an alarmingly high incidence of injury. Recently, footwear specifications have been explored as a method to mitigate this incidence, but often result in ambiguous and highly individualized outcomes. Footwear with reduced cushioning has been found to result in kinematic adaptations that influence key kinetic variables that have been linked to running related injury. The aim of this study is to determine the influence of footwear with reduced cushioning on kinematic and kinetic variables of novice runners who perform a progressive 12-week running intervention. Additionally, the study aims to relate these adaptations to running-related injury.
Methods
Fifty-four participants were recruited to take part in the study, with forty-four participants completing the 12-week running intervention. Participants were allocated into one of two groups, those wearing reduced-cushioned (RC, n=20) footwear and those wearing traditionally cushioned (TC, n=24) footwear for the duration of the 12-week running intervention. Three-dimensional biomechanical gait analysis was conducted at baseline, 6-weeks and 12-weeks. Key variables measured included foot strike angle (FSA), ground reaction force (GRF), initial loading rate (ILR) and spatiotemporal variables.

Results
The results showed that no differences in FSA were found between the RC and TC groups prior to the intervention. Furthermore, neither RC nor TC group showed any significant change in FSA over the course of the 12-week running intervention.
The RC group was split into responders (n=14, those who presented with a decrease in FSA after 12-weeks), and non-responders (n=6, those who presented with an increase in FSA after 12-weeks). The responders showed a significant reduction ($p<0.01$) in GRF, but showed no change in ILR over time. The reduction in GRF was not associated with a change in stride frequency or stride length. The non-responders in the RC group, as well as the TC group showed no significant changes in ILF and GRF over time.
Discussion
These findings suggest that the risk of running related injury was not influenced by footwear construction. However, those who presented with a reduction in FSA after 12-weeks when wearing shoes with reduced cushioning showed a significant reduction in GRF which was not coupled with an increased stride frequency. This interaction between kinetics and spatiotemporal variables suggests that the accumulative load is reduced, which may ultimately reduce the risk of running related injury.

HOW ACCURATE IS VISUAL DETERMINATION OF FOOT STRIKE PATTERN AND PRONATION ASSESSMENT

MEYER, F.1, FALBRIARD, M.2, AMINIAN, K.2, MILLET, G.P.1
1. UNIVERSITY OF LAUSANNE, 2. SWISS FEDERAL INSTITUTE OF TECHNOLOGY

Introduction
Shoes manufacturers usually propose shoes with two main characteristics: soles with different drops to fit rear-foot (RF), mid-foot (MF) and fore-foot (FF) strikers, and neutral shoes vs. with arch support for pronators. The foot strike index indicates the location of the centre of pressure when the foot hits the ground (Cavanagh and Lafortune 1980). Altman et Davis (2012) showed the agreement between foot strike index and foot strike angle measured using 3D motion system. The pronation of the foot has also been measured using different methods. Brody (1982) proposed a method called navicular drop while McClay et Manal (1998) used a 3D motion system to measure the peak eversion angle. The aim of this study was therefore to compare the accuracy of the previously cited methods with a visual assessment from experts who analysed slow motion videos.
Methods
34 healthy adults volunteered to participate to this study. They had to perform a 30 second trial at 12 km/h barefoot and then shod at 8, 12 and 16 km/h. Reflective markers were placed on their feet and recorded by 3D motion infrared cameras. All trials were also recorded using a lateral and a back camera. Three dimensional orientation of each foot was computed and categorisation of RF, MF and FF was determined using the foot strike angle method. Pressure insoles data was computed to determine the foot strike index. Finally, three experts visualized the videos recorded to determine foot strike pattern and pronation of the foot.
Results
Agreement on classification between foot strike angle and foot strike index was 88%, lateral visual classification and foot strike index: 92% and lateral visual classification and foot strike angle: 92%. ICC between experts was 0.89. Agreement on pronation classification using eversion angle and navicular drop was 46%, back visual classification and navicular drop, 42% and back visual classification and eversion angle, 55%. ICC between experts was 0.05.
Discussion
Classifying foot strike pattern using a single camera placed laterally seems very accurate to determine foot strike pattern. There is a good agreement between the three methods used in this project and experts also gave accurate results. Classifying the pronation of the foot using the back camera leads to another conclusion: the agreement between the navicular drop, eversion angle and back visual classification is very low. This can probably be explained by the fact that the three different methods measure slightly different parameters: eversion angle determines only the rear-foot eversion at ground contact, navicular drop classifies the foot in a static way, while experts estimated a malfunction of the foot that increases the risk of injury.
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DOES "LIVE HIGH-TRAIN LOW " HYPOXIC TRAINING ALTER RUNNING MECHANICS IN ELITE TEAM-SPORT ATHLETES?

BROCHERIE F., MILLET G.P., MORIN J.B., GIRARD O.
FRENCH INSTITUTE OF SPORT (INSEP)

Introduction
Although historically used by endurance athletes, altitude training has recently gained popularity in many professional team sports (Girard et al., 2013), and this has led to interest in its underpinning haematological and ventilatory adaptations (Chapman et al., 2014). Comparatively, the neuro-mechanical aspects of altitude training have almost never been explored. We investigated if "Live High-Train Low (and High)" hypoxic training alters constant-velocity running mechanics in elite team-sport athletes.
Methods
While residing under normobaric hypoxia (≥14 h.d-1; FiO2 14.5-14.2%) for 14 days, twenty lowland male elite field hockey players performed, in addition to their usual training in normoxia, six sessions (4 × 5 × 5-s maximal sprints; 25 s passive recovery; 5 min rest) under either normobaric hypoxia (FiO2 ~14.5%, n=9; LHTLH) or normoxia (FiO2 20.9%, n=11; LHTL). Participants were blinded to the environmental conditions. Before and immediately after the intervention, their running pattern was assessed in normoxia at 10 and 15 km.h-1 as well as during six 30-s runs at ~20 km.h-1 with 30-s passive recovery on an instrumented motorised treadmill.
Results
No clear changes in running kinematics and spring-mass parameters occurred globally either at 10, 15 or ~20 km.h-1, with also no significant time × condition interaction for any parameters ($P>0.14$). Independently of the condition, heart rate (all $P<0.05$) and ratings of perceived exertion decreased post-intervention (yet significant only at 15 km.h-1, $P<0.05$).
Discussion
Despite improved psycho-physiological responses, no forthright change in stride mechanical efficiency occurred during low-to-moderate constant-submaximal and high-intensity intermittent treadmill runs in elite team-sport athletes after "Live High-Train Low" hypoxic training

with additional repeated sprints in either normobaric hypoxia or normoxia. We conclude that this type of hypoxic training does not modify the running mechanics of the players at low and high velocities.
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EFFECTS OF EXERCISE-INDUCED CHANGES IN MUSCLE MECHANICAL ADVANTAGE ON ENERGY COST AND MODULAR ORGANISATION OF RUNNING

SANTUZ, A., EKIZOS, A., ARAMPATZIS, A.
HUMBOLDT-UNIVERSITÄT ZU BERLIN

Introduction
It is proposed (Albracht and Arampatzis 2013) that a forward shift of the point of force application (PFA) during the stance phase of running could change the effective mechanical advantage (EMA) of lower limb's muscles. This would lead to a reorganisation of the neuromuscular output aiming at improving the running economy (RE). The purpose of the current study was to investigate whether an exercise-induced forward shift of the PFA could affect RE. We hypothesized a decrease in the metabolic cost of running due to an improved efficiency of the fundamental muscle synergies.
Methods
We recruited 34 young (31 ± 4 y), healthy participants and randomly divided them into two groups. One group (G1, 10 male, 9 female) was assigned to a 14-week feedback-based PFA training. The other group (G2, 8 male, 7 female) served as control. In G2, seven participants dropped out of the study. All participants ran, shod, on an instrumented treadmill at 2.5 and 3.0 m/s. We recorded the breath-by-breath rate of oxygen uptake (VO2) and the electromyographic activity of 13 ipsilateral muscles of the lower limb. PFA was calculated elaborating plantar pressure distribution using a custom algorithm (Santuz, Ekizos, and Arampatzis 2016). The maximum isometric plantarflexion moment (MPM) was assessed before and after the training using an inverse-dynamics approach. Fundamental synergies (linear combination of time-dependent motor primitives and time-invariant motor modules), were extracted using non-negative matrix factorisation (Santuz et al. 2017). Motor primitives were compared using the full width at half maximum (FWHM) and global maxima timing. Motor modules' similarity was assessed with the coefficient of determination (R2). For the statistics, all α levels were set to 1%.
Results
PFA changed significantly in G1 after training (strike index: at 2.5 m/s +34.3%, p=0.003; at 3.0 m/s +31%, p=0.009). In none of the groups there were significant differences in pre and post RE and MPM values. Changes in the modular organisation were significant only in G1. Specifically, motor modules of synergy 3 (early swing) were dissimilar at both speeds (p=0.002 and p=0.009). At 2.5 m/s, the primitives' differences of synergy 4 (late swing) were visible in both FWHM (-20.2%, p<0.001) and global maxima timing (+1.2%, p=0.007). At 3.0 m/s, the primitives of synergy 3 appeared shifted (+9.0%, p=0.002).
Discussion
Results clearly showed that the direct training of PFA could not affect RE nor MPM. However, we could demonstrate an evident reorganisation of lower leg's muscles due to the forward shift of the PFA. We conclude that, in spite of the clear evidence of a reorganisation of motor control after PFA training, said changes could not alter RE, possibly due to negligible improvements in the muscle-tendon properties.
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Oral presentations

OP-BN21 Neuromuscular fatigue

FATIGUING NEUROMUSCULAR ELECTRICAL STIMULATIONS ALTER FORCE PERCEPTION BY DECREASING THE PERCEIVED EFFORT AT SUBMAXIMAL FORCE LEVELS

MONJO, F., FORESTIER, N.
UNIVERSITY SAVOIE MONT-BLANC

Introduction
Force perception has been proposed to rely on a sense of effort (Carson et al. 2002), namely the conscious awareness of the motor commands sent to the muscles, and/or on feedbacks from tension receptors within the tendons and muscles (Luu et al. 2011). Yet, the sense of force has been shown to be altered as a result of fatiguing voluntary contractions. That is, subjects overestimate the force produced in their fatigued limb (Carson et al. 2002). Here, we tested the hypothesis that fatiguing neuromuscular electrical stimulation (NMES) would alter force perception in a specific fashion as compared to voluntary contractions.
Methods
In a first experiment, subjects were submitted to a contralateral isometric force matching task in which they had to reproduce the force generated by their reference arm flexors with their indicator arm flexors. Subjects had to match forces equal to 20 and 35% of their maximal voluntary contraction (MVC) force as accurately as possible before and after their indicator arm was submitted to a fatiguing NMES program (120 contractions, 3 s on, 3 s off, 30 Hz, pulse width 0,4 ms). In a second experiment, subjects were required to rate their perceived effort (RPE) while producing 35% of their control MVC force, both pre and post-NMES. In addition to force data, EMG signals (1000 Hz) from the biceps brachii and brachioradialis were recorded.
Results
In experiment 1, subjects matched the forces very closely before the NMES program. Yet, post-stimulation, despite significant drop in MVC force (~13%), forces in the fatigued arm were significantly higher as compared to the reference arm ($p < .01$). EMG analyses revealed increased amplitude post-NMES in the fatigued arm during the matching task ($p < .01$). In experiment 2, at 35% of pre-fatigue MVC, RPE decreased significantly post-NMES despite increased EMG amplitude ($p < .01$).

Discussion
Contrary to voluntary muscle fatigue, this study shows that electrically-induced muscle fatigue leads to an underestimation of muscle force (experiment 1). As demonstrated by the RPE scores in experiment 2, these biased perceptions are the result of decreased effort sensations post-NMES. This supports the view that muscle force is essentially perceived through a sense of effort. Furthermore, this study demonstrates that the afferent inputs resulting from NMES lead to changes within the central nervous system that reorganize the relationship between the amount of motor commands and the sense of effort. This has potential interesting implications for rehabilitation and sports performances.
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RECOVERY OF CENTRAL NERVOUS SYSTEM FUNCTION FOLLOWING COMPETITIVE FOOTBALL MATCH-PLAY

BROWNSTEIN, C., PARKER, P., DENT, J., HICKS, K., HOWATSON, G., GOODALL, S., THOMAS, K.
NORTHUMBRIA UNIVERSITY

Introduction
Competitive football match-play induces significant neuromuscular fatigue requiring several hours of recovery (Hoyo et al., 2016). While the presence of post-match fatigue is well established, the aetiology of this is not well understood, with the mechanisms of fatigue studied primarily from a peripheral viewpoint and limited evidence on the effects of match-play on central nervous system (CNS) function. Recent research has highlighted that following simulated football match-play, CNS function is impaired up to 72 hours post-exercise (Thomas et al., 2017). However, limited research exists following a competitive match. The aim of this study was to examine post-match fatigue and the time course of recovery following football match-play from central and peripheral origins.
Methods
Sixteen male semi-professional football players completed a 90-minute football-match. Pre-, post- and 24, 48 and 72 h participants completed a battery of neuromuscular, physical and perceptual tests. Maximal voluntary contraction (MVC) and twitch responses to electrical (femoral nerve) and magnetic (motor cortex) stimulation during isometric knee-extension and at rest were measures to assess central (voluntary activation, VA) and peripheral (potentiated twitch force, Qtw,pot) fatigue, and responses to single- and paired-pulse magnetic stimulation were used to assess corticospinal excitability and short-interval intracortical inhibition (SICI), respectively. A range of perceptual measures of fatigue and soreness were assessed via visual analogue scales. Physical measures included countermovement jump (CMJ), reactive strength index (RSI) and 20-m sprint performance.
Results
Competitive match-play elicited significant declines in MVC force which remained depressed at 48 h (-4%, $P < 0.05$) before recovering by 72 h. VA (motor point stimulation) was reduced immediately post-match (-8%, $P < 0.001$), remained depressed at 24 h (-5%, $P < 0.05$) before recovering by 48 h. Qtw,pot was reduced post-match (-14%, $P < 0.001$), remained depressed at 24 h (-6%, $P < 0.01$), before recovering by 48 h. No changes were found in corticospinal excitability or SICI. The temporal pattern of recovery of jump performance and neuromuscular fatigue was similar; while perceptions of fatigue persisted at 72 h.
Discussion
Fatigue and recovery following competitive match-play is determined by a combination of central and peripheral factors, which take up to 48 h to subside. The greater magnitude of peripheral fatigue indicates that mechanisms within the muscle provide the greatest contribution to post-match fatigue and recovery, which has implications for the implementation of recovery interventions. Vertical jump performance appears to be a sensitive marker of post-match neuromuscular fatigue and could be an appropriate tool to use in practice.
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EFFECT OF CONTRACTION INTENSITY AND SEX ON TORQUE FLUCTUATIONS DURING SUSTAINED ISOMETRIC KNEE EXTENSION CONTRACTIONS

WU, R., DELAHUNT, E., DITROILO, M., SEGURADO, R., DE VITO, G.
UNIVERSITY COLLEGE DUBLIN (IRELAND)

Introduction
A sustained voluntary isometric contraction is accompanied by torque fluctuations, a phenomenon which also depends on contraction intensity. Females are less susceptible to muscular fatigue than males; however, it is not clear if there are sex differences in torque fluctuations. The aim of this study was to investigate sex-related differences in knee extensors (KE) torque fluctuations and surface EMG (sEMG) during sustained isometric contractions performed at different intensities.
Methods
After measuring the maximal voluntary isometric contraction (MVIC) for both KE and knee flexors muscles, 23 subjects (24.3 ± 3 years; 12 males) performed, in randomized order, 30s isometric KE contractions at 20%, 50% and 80% MVIC. SEMG was recorded from the vastus lateralis (VL) and biceps femoris (BF) muscles. For all contraction intensities, the coefficient of variation (CV) for the torque, the root mean square (RMS) and median frequency (MDF) of sEMG were estimated over a 26s period in 1s and 0.5s epochs, respectively. To quantify the agonist (VL) and antagonist (BF) activation, EMG RMS values, for each muscle, were normalized to the RMS measured for that muscle when acting as an agonist during the MVIC. A linear mixed-effects model was used comparing slopes between time and each variable and their intercepts (time=0) for all contractions.
Results
In both sexes, MDF decreased significantly over time at all intensities suggesting that neural fatigue was induced by the protocol. No sex-related difference was observed in terms of CV (intercepts) at all contraction intensities, but females exhibited a more evident increase (slope) than males at 80% MVIC. Males demonstrated a higher level of agonist (VL) activation and a greater increase than females at both 20% & 50%; but not at 80% MVIC. Furthermore, compared to females, males displayed similar levels of antagonist (BF) coactivation and a more pronounced increase at 20% & 50% MVIC, but a smaller antagonist coactivation and a similar rate of increase at 80% MVIC.
Discussion
The main findings were: no sex-related differences were observed for the amplitude (intercept) and change (slope) of torque fluctuations (CV) at 20% & 50% MVIC, but females had a higher fatigue-induced torque fluctuations at highest intensity; males showed a higher level

of agonist (VL) activation and a greater increase in both agonist activation and antagonist (BF) co-activation over time, particularly at lower intensities. Overall, our results could suggest that during lower intensity isometric contractions, males adopt different activation patterns compared to females, by gradually recruiting more motor units to maintain the same level of KE torque output.

Contact
rui.wu.1@ucdconnect.ie

IS REACTION TIME ALTERED BY MENTAL OR PHYSICAL EXERTION?

LE MANSEC, Y., DOREL, S., NORDEZ, A., JUBEAU, M.
LABORATOIRE MOTRICITÉ, INTERACTIONS, PERFORMANCE

Introduction
Reaction time (RT) is defined as the time interval between the onset of a stimulus and the moment when a response is initiated, and is classically fractionated into two components, i.e., premotor time (PMT) and electromechanical delay (EMD)(Weiss, 1965). Previous studies reported contrasted results regarding physical exertion effects on the RT, PMT and EMD, while the effects of mental exertion are still debated. Therefore, the present study aimed to assess the effects of both mental and physical exertion on RT components.
Methods
Thirteen men randomly performed three separated sessions: mental exertion was induced by completion of a mathematical cognitive task during a first session, physical exertion was induced by completion of intermittent contractions of the elbow flexors in a second session, and the third session served as a control (watching a movie). Pre and post-tests were composed of psychological (NASA-TLX) and neuromuscular (maximal voluntary contractions [MVC] and rate of force development [RFD]) measurements. RT and its components (PMT and EMD) were also assessed before and after completion of each fatigue protocol. RT was measured as the time between a visual stimulus and the initiation of an isometric contraction of the elbow flexors. PMT was measured as the time between the visual stimulus and the onset of electromyographic (EMG) activity, which was recorded by using an electrode array (64 channels). EMD was measured as the time gap between RT and PMT.
Results
While MVC and RFD were not changed after both mental and control sessions, they decreased after physical exertion (-18% and -43%, respectively, $p<0.001$). A significant greater mental demand was observed after completion of the cognitive task whereas a greater physical demand was shown after completion of the isometric contractions. RT and PMT were not significantly changed after the 3 protocols. Although no significant interaction time x condition was found for EMD, a trend of increased EMD time was observed for physical exertion protocol (+ 26%, $dz=0.654$).
Discussion
Our study showed that RT was not altered by both mental and physical exertions. For the mental exertion protocol, this result could be partly explained by the characteristics of the task, i.e., contraction of the elbow flexors, which did not alter the motivation of the subjects (Langner et al. 2010). For the physical exertion protocol, although EMD tended to be lengthened, this negative effect did not result in a significant increase in total RT, as EMD only represents a small part of it (i.e., 12%).
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EFFECTS OF ANODAL TRANSCRANIAL DIRECT CURRENT STIMULATION ON CORTICOSPINAL EXCITABILITY DURING A SUBMAXIMAL VOLUNTARY CONTRACTION SUSTAINED TO FAILURE

ABDELMOULA, A., BAUDRY, S., DUCHATEAU, J.
UNIVERSITÉ LIBRE DE BRUXELLES

Introduction
Anodal transcranial direct current stimulation (a-tDCS) is known to increase motor cortical excitability, as assessed by the recording of motor evoked potential (MEP) induced by transcranial magnetic stimulation (TMS). It has also been reported that it increased the time to task failure of a sustained submaximal contraction of elbow flexor muscles but without any change in corticospinal excitability (1). As MEP amplitude may depend on adjustments located at both cortical and spinal levels (2), the concurrent effects of a-tDCS and neural fatigability due to the sustained contraction may have induced opposite changes within the corticospinal tract, masking thereby the increase in cortical excitability. To investigate this possibility, we assessed the effect of a-tDCS during a sustained contraction performed with the abductor pollicis brevis (APB) as in this muscle, Hoffmann (H) reflex and long-latency reflex (LLR) can be recorded concomitantly with MEP. Furthermore, greater a-tDCS effect can be expected as monosynaptic corticomotoneuronal projections are more numerous in hand than arm muscles (3).
Methods
Ten adults performed two successive isometric contractions (C1 & C2), separated by 1-hr interval, with the right APB until failure at 35% of their maximal force. Each subject participated in two counterbalanced sessions, one with a-tDCS applied over the left motor cortex during the last 10 min of the 1-hr interval, the other with sham stimulation. Surface electromyogramme (EMG), H reflex, LLR and MEP were recorded during both contractions and sessions.
Results
The time to failure was briefer for C2 than C1, with a similar extent of reduction in both sessions (~12 %). Regardless of the session, the EMG activity did not change during the sustained contractions ($p>0.05$). In contrast, MEP amplitude increased (+37%) during each contraction, with no difference between sessions ($p>0.05$). H reflex amplitude did not change during C1 and C2 ($p = 0.08$), whereas LLR amplitude increased similarly ($p = 0.03$) in both sessions and contractions ($p>0.05$).
Discussion
In contrast to elbow flexor muscles (1), the time to task failure of C2 was not influenced by a-tDCS, suggesting a muscle-dependent effect. As reported previously (1), a-tDCS did not influence corticospinal excitability during C2. The results of these studies indicate a dissociation between the increase in corticospinal excitability and in the time to task failure, and highlight limitations in the use of a-tDCS to reduce muscle fatigability.
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Oral presentations

OP-PM59 Effects of exercise in obesity

EFFECT OF EIGHT WEEKS OF YOGA EXERCISES ON C-REACTIVE PROTEIN AND SLEEP QUALITY IN NON-ATHLETE OBESE MEN

KARIMI, M.

QOM UNIVERSITY OF TECNOLOGY

Introduction
Sleep disorders causes to weakness of immune system and stimulating of inflammatory factors such as C - reactive protein and finally increases of cardiovascular disease (Lau et al., 2005). Numerous research accomplished about exercise effects on sleep quality and inflammatory indices in different groups, but there are a few studies about yoga exercises effects on mentioned indices in obese men. The aim of this research was to study the effect of eight weeks of selected yoga exercises on sleep quality and plasma levels of C-reactive protein in non-athlete obese men.
Methods
To this aim, twenty accessible non-athlete obese men with body mass index equal or more than 30 kg/m2 were selected as subject and divided randomly into two equal groups of control (regular life) and experimental (yoga exercises). The experimental group performed eight-week selected yoga exercises, three sessions per week and each session lasting 60-75 minutes. Before and after exercise intervention, blood samples were collected from all participants at 12h fasting state. Plasma levels of C-reactive protein was assayed using standard commercial ELISA kits and Sleep quality evaluated using Pittsburgh Sleep Quality Index (PSQI). Data were analyzed using ANCOVA test ($p<0.05$).
Results
The results indicated that eight weeks yoga exercises lead to significant reduction in C-reactive protein (0.54±0.15 ng/ml before, Vs 0.41±0.16 ng/ml after) ($p<0.05$) and sleep quality index (9.41±1.69 before, Vs 6.47±1.20 after) ($p<0.05$) in non-athlete obese men.
Discussion
Inflammatory conditions and sleep disorders are the consequences of obesity (Van Cauter et al., 2008). Most of the investigations on this field, indicated that exercise may be a perfect intervention to modify these conditions. According to the results of this study, it seems that yoga exercises may have positive effects on reduction of sleep disorders that related to inflammatory markers such as C - reactive protein in obese men.

THE EFFECTS OF 12 WEEKS PILATES REFORMER TRAINING ON MAXIMUM KNEE STRENGTH AND ENDURANCE IN OBESE AND LEAN WOMEN

UZUN, S.1, AKSU, S.1, SANLI, G.1, GERCEK, N.1, ODABAS, I.2.

MARMARA UNIVERSITY

Introduction
Pilates exercises have become popular in recent years, especially among woman. Both health practitioners and fitness specialists are getting encouraged to improve physical activity via different pilates regimens. It was shown that obese adults generate higher absolute strength and lower relative muscle torque than their lean counterparts (1). Therefore, the aim of this study was to examine the effects of 12 weeks pilates reformer training program on maximum muscle strength and endurance, and BMI in obese and lean sedentary women.
Methods
6 obese (age:34,7; height:166,2; BMI:36,1>35) and 6 lean (age:35,8; height:161,1; BMI:19,5<23) women volunteered to participate in the study. (BMI) also participated. Body composition, maximum knee muscle strength and muscular endurance, curls up tests were done to the participants before and after training program. They were trained with 3 days per week for 45 minutes throughout 12 weeks training program. Concentric isokinetic peak torque was assessed for the knee extensors and flexors from 2 sets of 5 maximum efforts at 60°/s and 180°/s (Biodex). Participants completed 50 contractions with maximum effort at 180°·s-1 for endurance test of extensors. Peak extension torque (PET) values were chosen separately from the first 3, mid 3 and last 3 contractions. PET values of first contractions taken as reference (100%) and percentage decrements were calculated for middle and last PET values. All peak torque values were normalized to body mass.
Results
The findings for muscular endurance test were as follows; percentage decrement in PET, from first to middle contractions, was significantly lower after training in obese group only for left leg. However percentage decrement from first to last contractions was significantly higher after training in lean group for left leg ($p< .05$). There was no significant difference found in percentage decrements in PET between groups ($p< .05$).
Discussion
The findings from voluntary isokinetic muscular endurance (fatigue) test for knee extensors showed that female obese participants' fatigue resistance increased compared to their lean counterparts in the left limb, after 12 weeks pilates reformer exercises. According to the literature a reduced percentage of type-I and an increased percentage of type-IIb muscle fibers are present in obese individuals compared to their lean counterparts (1,2). Therefore increase in fatigue resistance in obese women may indicate that the percentage of type-I fibers increased in the left leg as an effect of the pilates training. On the contrary to our results, Maffiuletti et al. found that male obese individuals demonstrated lower fatigue resistance during voluntary knee extensions compared to their non-obese counterparts (1). This difference may be the result of difference in fiber type distribution between men and women. Future studies with a higher number of subjects are indicated for further analyses.
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THE EFFECT OF EIGHT WEEKS COMBINED AEROBIC EXCERCISE ON ED VARIABLES OF OBESE WOMEN

YILMAZ, N., ÖZGÜR, O.B., ÖZGÜR, T., KEPOĞLU, A.
SCHOOL OF PHYSICAL EDUCATION AND SPORTS

Introduction
Obesity has become one of the biggest global health problems. Inactive life style is also considered to be one of the biggest causes of the obesity. The purpose of this study therefore, was to evaluate the effects of eight weeks of regular exercise on body weight, body mass index (BMI), body fat percentage (BFP), lean body weight (LBW) and fatty body weight (FBW) in overweight and obese sedentary women who participating to a sports center.
Methods
A total of 133 participants aged 25 to 44 years (n = 84) and 45 to 64 years (n = 49) were recruited to the present study from the sports center of Istanbul Kagithane Municipality. The average age and height of subjects was 42,07 ± 8,76 years and 158,64 ± 5,64 cm respectively. Participants were instructed to exercise twice a week and one hour a day. On the first exercise day of the week, 40 minutes of aerobic exercise and 10 minutes of resistance exercise afterwards; On the second exercise day of the week, 50 minutes of plates workout and a step aerobics session upon 10 minutes warming up were applied. After the data was presented as descriptive statistics, analyses were conducted. The significance level was set to $p < 0.05$.
Results
According to Repeated Measure test results, there was no significant difference in the lean body weight ($p = 0,899$) variable ($p > 0.05$). However, there were significant differences in the variables ($p<0.05$) of body weight ($p=0,0260$), body mass index ($p=0,012$), body fat percentage ($p=0,047$), lean body weight ($p=0,012$) and fatty body weight ($p=0,047$). In the Bonferroni test, these differences were found to be due to measurements 2 and 3.
It has been found that the combined aerobics exercise, which was held for twice a week and one hour a day, makes a significant difference in the variables mentioned.
Discussion
Regular physical activity and physical fitness make important contributions to one's health, sense of wellbeing, and maintenance of a healthy body weight (U.S. Department of Health and Human Services). The current study has revealed that use of eight-weeks combined aerobics exercises, which was held for twice a week and one hour a day, make significant differences in BW, BMI, BFP and FBW, except for LBW. In an effort to provide insight into the study results, we've searched the existing literature. Habibzadeh, 2010 stated that percent body fat, fat mass and lean mass were affected positively by exercise which positively influences BMD in young thin and obese girls. As shown previous studies which have similar results to the results of the current article, it has been shown that regular combined aerobic exercises provide important contributions to human life, especially in sedentary, overweight and obese individuals.
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Contact
yilmaznurkan@gmail.com

AN 8-WEEK COMBINED EXERCISE AND DIET INTERVENTION IMPROVES ENDOTHELIAL FUNCTION, ENDOTHELIAL PROGENITOR CELLS AND CIRCULATING IRISIN IN OBESE ADULTS

HUANG, J., HU, M., WANG, S., XU, F., WANG, D., YIN, H., LAI, Q., LIAO, J., HOU, X.
GUANGZHOU SPORT UNIVERSITY

Introduction
The objective of this study was to investigate the effects of weight loss through combined exercise and diet intervention on endothelial function, endothelial progenitor cells (EPCs) and cardiovascular risk factors in obese people.
Methods
Seventeen obese adults completed an 8-week weight loss program with combined exercise and diet intervention. Anthropometry, body composition, aerobic fitness and multiple biochemical markers were measured. Endothelial function was assessed by flow-mediated dilation (FMD) test. EPC levels were evaluated by flow cytometry. EPC migratory and adhesive functions were determined.
Results
The intervention decreased body weight and BMI, whereas improved aerobic fitness and FMD. Furthermore, the intervention improved several cardiovascular risk factors such as lipid profiles, insulin, tumor necrosis factor-alpha (TNF-α), high-sensitivity C-reactive protein (hsCRP), superoxide dismutase (SOD), vascular endothelial growth factor (VEGF), endothelial nitric oxide synthase (eNOS) and adiponectin. EPC number, EPC migratory and adhesive functions and circulating irisin level improved after intervention. Additionally, a significant association between the change in irisin and the change in EPC number was observed after intervention.
Discussion
In conclusion, an 8-week combined exercise and diet intervention elevated circulating irisin associated with increase of EPC levels, which might contribute to the improvement of endothelial function in obese adults.

CYTOKINES AND MAKERS OF INSULIN RESISTANCE RESPONSE DURING A MONTH OF DETRAINING IN AEROBIC- AND RESISTANCE-TRAINED OBESE MEN

NIKSERESHT, M., TAHERI-KALLANI, A.1
1: ISLAMIC AZAD UNIVERSITY, ILAM BRANCH, ILAM, IRAN

Introduction
Training-induced physiological and metabolic adaptations reduced during detraining (Mazzucatto, Higa, Fonseca-Alaniz, & Evangelista, 2014), but researches are limited about the comparison of the effects of detraining after different types of training. Thus, the aim of this study was to determine and compare the effects of a month detraining on cytokines and markers of insulin resistance in aerobic- and resistance-trained obese men.

Methods
Nineteen obese trained men (resistance (RT), age = 35/2 ± 2/2 years, body fat%= 26/9 ± 0/1, n=10; aerobic (AT), age = 35/3 ± 1/4 years, body fat% = 28/5 ± 1/0, n=9) avoided to perform any exercise for a month. All subjects were taken blood samples to measure serum concentrations of interleukin (IL)-10, IL-17A, IL-20, glucose and insulin before and after detraining.
Results
Similarly, body fat percentage increased significantly in both groups compared to the baseline after detraining; however, serum levels of glucose significantly decreased. Compared to the baseline, no significant changes were observed in IL-10, IL-20 and insulin resistance during detraining in the groups ($p > 0.05$), but IL-17A ($p= 0.049$) and insulin ($p = 0.012$) were significantly increased in the RT (but not for AT).
Conclusion
After detraining, insulin and IL-17 levels increased significantly in the RT. So far, IL-17 response to detraining has not been studied. However, the role of IL-17 in stimulating inflammatory cytokines (such as IL-6 and tumor necrosis factor-alpha) has been demonstrated (Aggarwal & Gurney, 2002). Therefore, it is suggested that at least part of insulin increases in the RT was due to the increase in IL-17. In conclusion, theses data indicated that the negative changes a month of detraining is more prominent in the RT (with an increase in insulin and IL-17A). Thus, it is recommended that the resistance training should not be discontinued to prevent worsening of inflammatory conditions.
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Contact
nikserasht@gmail.com

SEDENTARY BEHAVIOUR AND OBESITY IN ADULTS: APPLYING THE BRADFORD HILL CAUSALITY CRITERIA

BIDDLE, S.
VICTORIA UNIVERSITY

Introduction
Sedentary behaviour – low energy sitting or lying down during waking hours – is a popular topic of research within the field of the 'movement sciences'. Claims for deleterious health effects of high levels of sitting have included various health outcomes, including mortality and cardiometabolic health. Many have claimed that obesity is also related to sedentary behaviour and this was one of the first areas to be researched in the context of sitting. However, the evidence is often mixed and various exposure and outcome measures have been used. This paper presents evidence on the causal nature of any association between sedentary behaviour and obesity in adults.
Methods
Ten systematic reviews were located through searches and a 'review of reviews' was undertaken. Key factors from the Bradford Hill criteria for judging causality were assessed: strength of association, temporal sequencing, coherence and biological plausibility, dose-response relationship, and experimental evidence.
Results
Strength of association is poorly reported, but with some evidence of small effects for older adults. Temporal sequencing is moderate-to-weak with mixed or no effects in adult prospective studies, but some evidence for sedentary behaviour in pre-adulthood predicting adult obesity. But reverse causality has also been shown. Coherence and biological plausibility is moderate with evidence for co-existing obesogenic behaviours. Dose-response is moderate-to-weak and poorly addressed in the reviews, while experimental evidence is inconsistent and indicative of very small effects.
Discussion
While there is some evidence for obesity being associated with screen time and car use, and for breaks in sitting time, it is not possible to conclude that any association between sedentary behaviour and obesity in adults is causal.

Invited symposia

IS-SH08 Serious Games in sport and health – Chances and challenges

SERIOUS GAMES IN SPORT AND HEALTH – A CRITICAL REVIEW

WIEMEYER, J.
TECHNISCHE UNIVERSITAET DARMSTADT

Serious Games (SG) offer new options for learning and training in sport and health. For example, Serious Games have been successfully applied to improving perceptual or sensorimotor abilities. Furthermore, Serious Games have been applied to change health-related behavior like physical activity, nutrition, and drug (ab-)use.
However, two main shortcomings exist: First, high-quality studies like randomized controlled trials (RCT) can only be found in few domains. Whereas there are numerous proofs for the effectiveness of SG in balance, spatial abilities, and reaction as well as a low to moderate increase of energy expenditure, the area of motor learning has been neglected so far. Existing evidence is sparse and shows that transfer of SG training works either on an elementary ability level or at a cognitive level, e.g., strategic thinking or motor imagery. Attempts to enhance sports skills have not been successful. Furthermore, positive effects of SG seem to be limited to specific conditions like low initial level. Applications to conditioning training are also very rare.
Second, most SG lack scientific substantiation. Rather, commercial off-the shelf systems or intuitive technology-driven approaches dominate resulting in the problem that the full potential of SG may not be exploited.
Therefore, appropriate studies as well as scientifically substantiated SG are needed. Furthermore, SG technology has to be improved, particularly of skill learning and conditioning.
References

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SCREEN TIME IN PRESCHOOL: RELATIONSHIPS WITH CHILDREN'S PHYSICAL ACTIVITY AND OUT-OF-SCHOOL SCREEN-TIME

STAIANO, A.E., JOSEPH, E., ALLEN, A.T., WEBSTER, E.K., MARTIN, C.K.
PENNINGTON BIOMEDICAL RESEARCH CENTER

Introduction
To determine the associations of preschoolers' in-school screen-time with in-school physical activity, free play, and out-of-school screen-time.
Methods
Fifty-nine children (3.3 ± 0.4 years of age; 47% female) enrolled in three child care centers participated. In-school screen-time and physical activity were ascertained by a director's survey and by direct observation using the Environment and Policy Assessment and Observation tool. Parents reported child's age, sex, and household income. Parents also reported child's out-of-school screen time by responding to the question "During the past 30 days, on average how many hours per day did your child sit and watch TV or videos outside of school?" Additional questions queried how many hours per day did the child "use a computer or play computer games," "play video games," "use a smartphone," and "use an iPad or tablet." Children's height and weight were collected using standard procedures, and body mass index (BMI) was calculated. Pearson correlations were used to examine associations among variables. Linear regression models were used to examine the associations among screen-time and physical activity (age, sex, and household income were retained as covariates when $p < 0.05$).
Results
Children were engaged in an average of 5.6 hours/day of screen-time outside of school (parent-reported), plus 35 min/day (based on observation) or 17 minutes/day at school (based on director's report). Based on observation, children engaged in 123 minutes/day of physical activity at school. More free play time reported by the director was positively correlated with more observed physical activity ($r = 0.73$, $p < 0.0001$) but also with more screen-time ($r = 0.60$, $p < 0.0001$). Children who had more screen-time in-school also watched more TV outside of school ($p = 0.03$), but this relationship was not significant for time spent with other devices. Interestingly, higher observed screen-time was related to more observed physical activity in school ($p < 0.0001$) in models controlling for household income.
Discussion
Preschool children who were exposed to more screen-time at preschool engaged with more television viewing outside of school. Free play at school appears to facilitate both physical activity and screen-time, which may be influenced by equipment available to the children as well as teacher modeling or guidance during free play. Identifying ways to reduce screen-time among preschoolers or to transform sedentary screen-time into physically active time is an important future direction for research.

Oral presentations

OP-SH05 Physical education and learning

PLACEMENT OF VOLLEYBALL UNIT AS A TEACHING MATERIAL THROUGH ACTION RESEARCH

NAKAZAWA, K., NISHIHARA, Y.
UNIVERSITY OF AIZU

Introduction
Lesson plans and reflective teaching and learning are what help achieve the effects of physical education. For formative evaluation of teaching, it is essential to consider students' perception of teaching. Based on the previous action research, we pointed out that the volleyball unit, which was taught second in the course, indicated that students' communication was activated and group cohesiveness was promoted through engagement with the unit. In this research, we planned a lesson in which the volleyball unit was placed first in the course based on reflection, and investigated the effect from the viewpoint of students' learning.
Methods
The physical education course lasted from the end of April to the end of July 2015. We asked the subjects to record simple notes after every class. At the end of the course, they were allowed to refer to these notes while describing their thoughts, which were classified into four categories; one per course unit and one labeled "throughout the course." We analyzed the documented responses via text mining. KH coder was used for this purpose.
Results
The eight selected codes were used as a framework to investigate students' reflection processes in relation to the three units. We compared the frequencies of occurrence and non-occurrence across the four categories in each code, after verifying the data through cross tabulation, and using Pearson's chi-squared tests, complemented by adjusted residual analysis, to assess associations between the categories. The frequency of the code "interaction" and "group cohesiveness" was the highest in the volleyball unit that was placed first in the course.
Discussion
The results from the volleyball unit, which was taught first in the course, indicated that students' communication was activated and group cohesiveness was promoted through engagement with the unit. By arranging volleyball units first, the adaptation of students to classes was accelerated. Along with students' adaptation, a new problem also arose; for instance, other challenges, such as competence of sports skills and individual differences in motivation, occurred. These results showed that the order and characteristics of units affected students' perceptions of the overall course. However, other factors could also influence students' perceptions. In conclusion, an appropriate teaching approach based on reflection can foster a favorable perception of education among students.
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DELIVERING PHYSICAL EDUCATION AND SPORT IN SELECTED SCHOOLS IN SOWETO : SOWETO ACTIVE SCHOOLS PROGRAMME

HOLLANDER, W.
UNIVERSITY OF JOHANNESBURG

Introduction
The Soweto Active Schools Programme is a joint pilot initiative of the Department of Education Gauteng (South Africa), Nike Africa, and the German International Cooperation (GIZ) to enhance physical activity in five primary schools in Soweto the biggest township in South Africa. The programme utilizes Physical Education (PE) during school time while building the capacity of PE teachers to teach PE and Extra School Support Programme (ESSP) coaches (A programme of the National Department of Education) to deliver school sport. The aim of the study was to evaluate the Soweto Active Schools Programme for optimal delivery.
Methods
The research constitutes a descriptive design, utilizing Programme Theory Assessment (PTA) methodology and integrating quantitative and qualitative data sets to provide information on the delivery of the programme. Purposive sampling conducted by the schools' decision-makers ensured optimal representation and inter-case comparisons. A total of 249 questionnaires were completed by three teachers delivering sport, 15 teachers teaching PE, and 231 Grade 5 and 6 learners. Forty-seven (47) research participants took part in focus group sessions, of which 30 were learners, nine HODs for PE, and eight teachers teaching PE. Principals and sport masters of all five schools made up the 10 interviewees. Quantitative techniques provided nominal data which was partly contextualized by the qualitative data and substantiated by the triangulation of the data sets. For the qualitative data set, line-on-line coding was utilized that rendered items for axial coding and theme development.
Results
Results indicated that although the programme theory has far-reaching benefits, aspects that should be attended are access to physical resources such as facilities and equipment, the level of training and preparedness of teachers, as well as the level of motivation and workload of teachers.

EXTRACURRICULAR SCHOOL SPORT IN THE SCHOOL – A NEW APPROACH BESIDES OUTSOURCING TO SPORTS CLUBS

KRAKOWSKI-ROOSEN, H., NONHOFF, T., LEYDAG, R., REIMER, A., HOFFARTH, J., GAHLEN, M.
UNIVERSITY OF APPLIED SCIENCES HAMM-LIPPSTADT

Background
School sport aims to encourage all children and young people to enjoy the movement and community sport, and to insist that continuous sports, combined with a healthy lifestyle, has a positive effect on their physical, social, emotional and spiritual development (1). It is supposed to do this in the context of curricular sports teaching, but also in the context of an extracurricular offer. Such an extracurricular offer is often only possible in co-operation with clubs and thus tied to the usual care in the afternoons and evenings.
Objectives
Development of a concept for the design of the extracurricular school sport, which can be self-arranged by the participating pupils in a timely manner and without supervision.
Methods
Analysis of spatial, temporal and economic conditions by questionnaires and interviews. CAD-based design planning. Project planning using MS Project.
Results
Movement space in the schoolyard, consisting of a 100 m natural running track (Finnenbahn) and connected 9 movement stations for coordination and force training.
Conclusions
Despite limited financial possibilities for extracurricular school sport and without explicit human resources, it is possible to create a movement and training facility on the compound of a German secondary school, which can be used by the pupils as part of the normal temporal exposure of a whole-day school and without supervision.
References
(1) Die Bedeutung des Schulsports für lebenslanges Sporttreiben. Gemeinsame Erklärung der Präsidentin der Kultusministerkonferenz, des Präsidenten des Deutschen Sportbundes und des Vorsitzenden der Sportministerkonferenz. Zweite gemeinsame Fachtagung zum Thema 'Perspektiven des Schulsports' Karlsruhe 12. - 13. Dezember 2005

INCLUSIVE OR EXCLUSIVE? AN EXAMINATION OF INTERPRETATIONS OF THE BODY IN PHYSICAL EDUCATION FROM THE PERSPECTIVE OF ABLEISM

RUIN, S.1, GIESE, M.2
1: GERMAN SPORT UNIVERSITY COLOGNE (COLOGNE, GERMANY), 2: HUMBOLDT-UNIVERSITÄT BERLIN (BERLIN, GERMANY)

Introduction
In our contemporary societies, interpretations of the body are multifaceted and in some cases even paradoxical. In the field of sport, there seem to be two conflicting interpretations which characterise our time. On the one hand, there is a global trend for physical self-optimisation which tends to functionalise and normalise the body (Foucault, 1977). On the other hand, societal claims for inclusion (UN, 2006) effect a struggle to achieve the acceptance of (bodily) diversity.
Methods
Using the theoretical perspective of ableism (Campbell, 2009) as an analytical perspective to help to reflect on and break out of exclusionary, discriminatory and prejudicial bodily practices, this study seeks to subject practices in the area of sport to critical reflection. It is especially concerned with physical education, which arguably plays a central role in wider efforts to create an inclusive society. With this

in mind, the meaning of the body in physical education in Germany (a country with a traditionally strong focus on homogeneous achievement in education) is examined in an explorative and hermeneutic manner. Existing findings about interpretations of the body (e.g. Ruin, 2015) in teaching methodology and conceptual framework, as well as educational policy and the curriculum are revised from the theoretical perspective of ableism.
Results
The observations reveal that there are numerous barriers facing the project of inclusion in the area of physical education at all levels. As well as the obviously problematic traditional implications in sport (such as normalised performance standards), the analysis shows that conceptual and curricular approaches that increasingly shift the focus onto the individual and his or her self-determined and self-reflected movements in the world, also imply exclusionary potentials.
Discussion
The findings make clear that at the level of teaching methodology and the conceptual framework of PE, there is a need to rethink existing concepts with the object of minimising implications with exclusionary potentials. A simple adaption of common concepts for students with special needs might fall short. In addition – at least in Germany – at the educational policy and curriculum level, the perspective of ableism reveals that children with special needs are rarely taken into account.
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A PART OF A BIGGER PICTURE – A COMPARISON OF PETE- STUDENTS' ATTITUDES TOWARDS INCLUSIVE PE IN GERMANY AND THE NETHERLANDS

MEIER, S.1, RUIN, S.2
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Concerning inclusive PE, especially in Germany findings highlight problematic implications (e.g. the body as a functioning object) on a conceptual level, which are carried out as well on the level of teacher attitudes (Giese & Ruin, 2016). Not least, the success of inclusive learning settings depends on the attitudes of teachers (Booth & Ainscow, 2011). Attitudes count as influential variables in teaching design and should be considered in PETE (Darling-Hammond & Bransford, 2005). Whereas Germany is known as a country with a highly selective school system it seems helpful to draw a comparison of PETE-students' attitudes with a country which has a more flexible one. This could promote knowledge about the attitudes of PETE-students, which is highly relevant to develop inclusive PETE as well as PE in future.
Methods
Against this background a framework was designed to give an insight into attitudes of PE teachers and PETE-students towards inclusive PE. Based on qualitative pre studies a quantitative specialist and requirement-specific test instrument was validated, which measures multi-dimensionally on a latent level (Meier et al., 2017). With this instrument the attitudes of PETE-students were recorded in Germany and the Netherlands (N=270).
Results
This international comparison highlights visible differences between both countries. Whereas the German PETE-students show similar attitudes to the existing findings (e.g. interpret the body as a functioning object), the Dutch differ significantly. Considering that the school system in the Netherlands is more flexible and therefore closer to the idea of inclusion, one can assume that the attitudes of Dutch PETE-students (among other things characterized by a stronger focus on individuality) seem more adequate.
Discussion
Even if this small study can only be understood as a starting point, it reveals striking differences, which provide important approaches to develop inclusive PETE as well as PE in future. This study already highlights the importance of working on international comparisons with various countries.
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Oral presentations

OP-SH06 Sport management and society

ETHNIC IDENTITIES, SENSE OF BELONGING AND THE SIGNIFICANCE OF SPORT

BURRMANN, U., MUTZ, M., BRANDMANN, K., ZENDER, U.
TU DORTMUND, JLU GIESSEN, TU DORTMUND, TU DORTMUND

Introduction
Germany is becoming a multicultural society with a growing migrant population. Issues of social integration and societal cohesion are ongoing themes in public debates. In this regard, sport is often considered as a tool for fostering integration and a sense of belonging among migrants. Hence, thorough empirical research on the complex relationship between sport participation and integration is still needed. This paper will build on the concept of belonging (Mecheril, 2003; Mecheril & Hoffarth, 2006) to elaborate on the means and modes of how sport club participation and the social and emotional dimensions of integration may be interrelated. The present study was part of a larger research project that addressed sports-related socialization processes among immigrant youths in Germany (Burrmann, Mutz & Zender, 2015).

Methods
Whereas the overall project framework was based on quantitative as well as qualitative data, the study presented here relies solely on qualitative research methods. We will present four case studies and thus employ a 'multiple case study' approach (Stake, 2005). This decision was made because we believe that these four particular cases can hold important insights about the multi-faceted relationship between sport and sense of belonging.
Results
All four interviewees represent immigrant youths from ethnic (Turkish, Moroccan, and Yugoslavian) minorities. They belong to the first or second generation, hence they are either born in Germany or migrated to Germany in early childhood. They all are in the age range of 16 to 18 years, thus representing late adolescence and all four come from Muslim backgrounds.
Discussion
Four case studies illustrate that sport can have manifold meanings and consequences for young people. It may work as means of emancipation (Büsra), but also reassert traditional values (Nasan). It can stabilize and provide hold in times of insecurity (Dejan) and may work as a source for reputation and respect in a disadvantaged social milieu (Youssuf). However, all four case studies highlight the ambivalence and inner conflicts that these immigrant youths have to face in sport and society. Moreover, they suggest that it is not sport per se, but the experiences of success and self-efficacy that result from athletic talent in combination with positive social interactions with 'significant others' in sport that matter.
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THE ACQUISITION OF MARKETING PERMISSIONS IN GERMAN PROFESSIONAL FOOTBALL CLUBS

HABENSTEIN, D.
FACULTY OF SPORT SCIENCE

Introduction
The acquisition of personal fan data is some of the main digital transformation challenges professional football clubs are faced with. The problem: in order to contact a fan via interactive communication, the clubs require the fans' marketing permission. The challenge: the acquisition-situations need to be attractive in such a way that the fan is willing to reveal his personal data with respect to the legal situation. The few existing studies like Andrade et al. (2002) or Premazzi et al. (2010) provide quiet different results, which determinants are drivers and barriers of a permission decision making. Therefore, the aim of this study was to examine how the acquisition of marketing permissions needs to be configured in order to increase the customers' willingness to provide personal data without neglecting the case law.
Methods
To answer the underlying research question, two methods have been used: First, an analysis of documents like newsletter registration forms or raffle participation cards from the 18 clubs of the German Bundesliga (followed by a content analysis) in order to verify the legal conformity of the current permission acquisition. Second, a scenario technique online-survey with 12 sample groups, each with 52 subjects (N = 624) to examine if and to what extend the fans' willingness to provide a marketing permission can be positively influenced by changing the contact channel, the offered incentives and the explanatory text. By using analyses of covariance, a comparison of the readiness to provide personal data between the different sample groups followed.
Results
The content analysis has shown that none of the 18 clubs of the German Bundesliga conducts a gapless, legally impeccable permission acquisition. As the online-survey approved, the type of demanded personal information, the contact channel and the detailedness of the explanatory text do have a significant impact on the fans' willingness to provide a marketing permission, whereas the use of incentives showed a relatively small influence.
Discussion
As the results have shown, the willingness to provide a marketing permission can be effectively influenced by the clubs. But some limitations need to be considered. The clubs are currently disregarding essential legal requirements, however the German legislation enables this due to several legal grey zones. The survey results bared a number of significant improvement potentials. Nevertheless, the explanatory power of the findings lies in the lower mid-range, so that further studies with additional variables need to be done.
References
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Contact
Dominic.habenstein@rub.de

INCULCATING THE CONCEPT OF THE NATION WITH AFFECTIVITY AND MORALITY: EFFECTS OF THE MEDIA'S FRAMING OF MAJOR SPORT EVENTS ON NATIONAL PRIDE AND NATIONAL VALUES

MUTZ, M., GERKE, M.
JUSTUS-LIEBIG-UNIVERSITÄT GIEßEN

Introduction
Scholarly research has shown that major sporting events can impact identification with the nation state and can add positive images to the concept of the nation. However, research has so far not conclusively tested which precise mechanisms account for these outcomes. One potential mechanism refers to emotional involvement and argues that the experience of shared emotions is fundamental for sense of belonging and solidarity in a group and leads to an emotional charging of the symbols representing the group.
Methods

Building on concepts like 'emotional contagion' and 'emotional conditioning', this presentation argues that TV sportscasts of major sporting events inculcate the concept of the nation with affectivity and morality.
Results
In an experimental study, conducted in Germany, individuals were exposed to different media presentations of the same sporting competition – a kayaking race from the 2016 Olympic Games. The sportscasts varied in their degree of emotionality (high emotionality vs. low emotionality). Findings show that respondents' identification with Germany is higher when they watched a highly emotional broadcast of the race compared to respondents who had watched the same competition framed in a factual way.
Discussion
Moreover, after having watched a highly emotional broadcast, Germany was associated with more positive emotions and values. It is concluded that highly emotional media frames enhance national pride and 'charge' the concept of the nation with emotions and meanings.

17:15 - 18:30

Plenary sessions

PS-PL01 INDIVIDUALITY - SOCIAL AND PHYSIOLOGIC PERSPECTIVES FOR FITNESS AND HEALTH

CONSUMERS, ACTIVE LEISURE AND PERFORMATIVE RATIONALIZATION

SASSATELLI, R.
UNIVERSITY OF MILAN

This paper looks at how fitness culture is evolving, interfacing sports practices as well as popular leisure culture, considering that commercialization has worked in two directions: while competitive, professional sport is becoming a global media phenomenon, with increasingly global and yet fragmented audiences, ordinary sport practice is being individualized in the Global North and shaped by the logic of therapeutic leisure which has long been dominant in fitness culture. The latter has given way to the diffusion of a variety of fitness and active leisure activities aiming at providing individual consumers meaningful experiences of body transformation. Exploring contemporary fitness culture, I consider how it further individualizes active leisure practices, while suggesting new relational and emotional codes. The paper looks in particular at the emotional set up of the fitness scene and proposes that spectacularization and individualizing self-surveillance are central to a culture which is organized around emotionally thick notions such as 'authentic', 'real experience', 'fun' and 'wellbeing'. While facing demographic changes fitness goals are adamant in all Nations in the Global West, such trends are particularly congenial to particular portions of the populations rather than others. The paper finishes of by considering the shortcomings of commercial fitness as spectacularized and individualized practices as opposed to more collectivized, sociable and embedded ways of organizing active leisure for the whole of the population.

INDIVIDUALITY - A PHYSIOLOGICAL PERSPECTIVE

HOPPELER, H.
UNIVERSITY OF BERN

The public interest in sport performances is mainly related to the outstanding performance that some individuals achieve in a particular discipline. Be it the 100m dash or the 42,195 km of the Marathon, it is an individual athlete who has covered the sprint or marathon distance in the shortest ever recorded time, who is the world record holder and who has the attention of the public. This individual feat of an athlete can be seen as the result of two aspects of the nature - nurture conundrum. If we look at "endurance performance", as an example, it becomes quite obvious, that you must be highly gifted with regard to your innate endurance capacity, physiologically estimated by VO2max, to stand a chance to ever become an Olympic champion or a world record holder. This, because the trainability of VO2max is limited. Maybe to 1.3-1.5 of your innate or spontaneous (untrained) VO2max. This indicates that only if you already have a reasonably high natural VO2max, training will eventually give you the necessary VO2max of 80mlO2/min and kg to be in the league of the potential Olympic endurance champions. In this context the second aspect of the nature – nurture conundrum comes in. Trainability is not the same for all. Trainability has been shown to be highly variable among individuals and there is therefore a complex interaction between the genome and exercise (Bouchard et al. Compr Physiol. 2011). However, as a huge number of genes impinge on the many physiological characteristics underlying a specific athletic performance it is apparent that there are many genetic variants allowing an Olympic win. Moreover, over the last decade it has become increasingly clear that our DNA carries markers, epigenetic tags, that importantly influence the availability of DNA for transcription and thus for the flow of information from DNA via mRNA to proteins. More recently even, similar tags have also been shown to exist on mRNA (Willyard, Nature 2017). These new findings are of importance for long lasting and eventually transgenerational non-genetic effects that influence gene expression and thus the phenotype of an individual.

Thursday, July 6th, 2017

08:00 - 09:30

Invited symposia

IS-PM03 TRAINING CHILDREN´S HEARTS - CARDIAC ADAPTATIONS TO EXERCISE AND TRAINING IN THE CHILDHOOD ELITE ATHLETE AND CHILDREN WITH HEART DISEASE

INSIGHTS FROM EXERCISE STRESS IMAGING IN CHILDHOOD ATHLETES AND CHILDREN WITH CONGENITAL HEART DISEASE.

PIELES, G.
BRISTOL HEART INSTITUTE

Until recently cardiac exercise physiology and pathophysiology was only indirectly assessed during CPET providing limited information on ventricular response and myocardial mechanics during exercise. This lecture will introduce the novel concept of cardiac exercise imaging to investigate myocardial exercise performance in elite childhood athletes and children with congenital heart disease. Illustrated by cases, normal and abnormal left and right ventricular exercise performance in children will be interrogated based on echocardiographic myocardial deformation imaging. This will provide new insights into cardiac adaptations and exercise performance of the childhood heart during elite sport and disease.

EXERCISE PERFORMANCE AND TRAINING ADAPTATION OF YOUNG ATHLETES

OBERHOFFER, R.
FACULTY OF SPORT AND HEALTH SCIENCE

Young athletes undergo long term physiological cardiac training adaptations like eccentric or concentric myocardial hypertrophy (1) which can be detected echocardiographically. However, the differentiation of beginning cardiac pathological conditions like Hypertrophic cardiomyopathy in the transition phase from childhood to adolescence is still difficult. The equivalent to training related cardiac changes in the ECG has also to be interpreted using age related standards, and applying the Seattle criteria (2) needs to bear in mind that they are not yet standardized for children and adolescents. Acute adaptation to exercise in children may be accompanied by heart rate increase and by diastolic filling limitations (3). This has to be taken into account when training recommendations in younger age groups are given. The impact of exercise on arterial thickness and distensibility in childhood and youth has still to be clarified.

(1) Huang et al. Med Diss in press
(2) Bessem et al. Br J Sports Med 49:1000-1006, 2015
(3) Hauser et al Ped Cardiol, 34:576-582, 2013

Invited symposia

IS-PM08 Dietary nitrate as an ergogenic aid

DIETARY NITRATE AS AN ERGOGENIC AID

VANHATALO, A.
UNIVERSITY OF EXETER

This lecture will highlight key discoveries in dietary nitrate research in human exercise physiology over the last decade. Following ingestion, dietary inorganic nitrate is reduced to bioactive nitrite and nitric oxide (NO), which are believed to mediate physiological effects observed after nitrate supplementation. Scientific interest on dietary nitrate in the field of exercise physiology accelerated after reports that nitrate supplementation, with doses that can be derived via vegetable rich diet, reduced the oxygen cost of submaximal exercise. It has since been shown under a number of different experimental conditions that dietary nitrate may reduce pulmonary oxygen uptake during exercise, reduce the metabolic cost of force production, and ultimately improve exercise tolerance and performance. Further studies have greatly advanced our understanding of conditions under which nitrate may, or may not, be ergogenic with implication for how, and when, to apply nitrate supplementation in research and applied settings. This lecture will also provide an overview of potential mechanisms underlying the effects, including alterations in skeletal muscle contractile and mitochondrial function, and blood flow.

WHO WILL BENEFIT FROM THE ERGOGENIC PROPERTIES OF NITRATE SUPPLEMENTATION?

VERDIJK, L.
MAASTRICHT UNIVERSITY MEDICAL CENTRE

Nitrate rich beetroot juice has become a popular sports supplement due to its proposed ergogenic properties. Whereas the earlier studies in this area mainly focused on endurance-type activities (i.e., cycling), more recent work has begun to unravel the effects on exercise performance in more high-intensity and interval type sport disciplines including soccer, rowing, and sprinting. Indeed, performance benefits have now been shown using various exercise test modalities such as Yo-Yo intermittent exercise testing as well as repeated 'all-out' sprint protocols for both running and cycling.

At the same time, given the beneficial effects of nitrate supplementation generally observed in untrained and moderately trained individuals, there is obviously great interest in the potential of dietary nitrate to enhance sports performance in a highly trained and/or elite setting. Based on the first findings, it has been hypothesized that highly trained, elite endurance athletes may be less responsive to the ergogenic properties of nitrate when compared with recreational athletes. However, the question remains whether the lack of any observed effects in elite endurance athletes is indeed caused by such 'unresponsiveness' and to what extent this may be related to the exercise modality. Or, alternatively, whether the subtle improvements that may occur are simply too small to enable reliable detection given the methodological limitations inherent to sports performance testing. In this lecture, we will discuss to what extent the ergogenic benefits of nitrate supplementation may be dependent on the training modality as well as the training status of athletes, with due attention for the elite athlete in particular.

PRACTICAL APPLICATION OF DIETARY NITRATE SUPPLEMENTATION IN SPORTS

BURKE, L.

AUSTRALIAN INSTITUTE OF SPORT

Scientific investigation of dietary nitrate supplementation for sports performance has followed the conventional model whereby laboratory (and occasionally field-based) protocols have isolated the effect of nitrate on a single performance under standardized conditions of pre-trial diet and exercise. In the real world, however, athletes can be required to compete in a series of heats and finals to determine the overall winner of an event, and may want to integrate the use of dietary nitrate into a program that includes a range of other performance supplements or nutritional strategies. Understanding whether they are an individual responder to nitrate supplementation, or whether other conditions of the competition or training scenario (e.g. altitude training) affect the efficacy of nitrate use is also important. This presentation will examine the evidence for the application of nitrate supplementation within the more complicated world of sports performance as well as present information on current practices and issues for further investigation.

Oral presentations

OP-PM08 ESSA – ECSS Exchange:Thermoregulation

ESSA – ECSS EXCHANGE : SHOULD ENDURANCE ATHLETES COMPETING IN THE HEAT FOCUS ON COOLING BEFORE OR DURING COMPETITION?

STEVENS, C., NOVAK, A., TAYLOR, L., CALLISTER, R., DASCOMBE, B.

SOUTHERN CROSS UNIVERSITY

Introduction
A large research emphasis has been placed on cooling the body prior to exercise (pre-cooling) for the improvement of endurance performance in the heat. However, cooling during exercise (mid-cooling) when the body is already under heat stress may be more beneficial. Therefore the purpose of this study was to compare the effect of practical pre-cooling and mid-cooling methods on endurance running performance and physiology in the heat.
Methods
Eleven trained male runners (VO2max = 61 ± 6 mL.kg-1.min-1) completed familiarisation and four randomised, pre-loaded running time trials (20 min at 70% VO2max followed by a 3 km time trial) on a non-motorised treadmill in the heat (33 degrees C). Trials consisted of pre-cooling by combined cold-water immersion and ice slurry ingestion (PRE), mid-cooling by combined facial water spray and menthol mouth rinse (MID), a combination of all methods (ALL) and a control (CON). A range of physiological responses was measured throughout the trials.
Results
Performance time was significantly faster in MID (13.7±1.2 min; P<0.01) and ALL (13.7±1.4 min; P=0.04) but not PRE (13.9±1.4 min; P=0.24) compared to CON (14.2±1.2 min). Pre-cooling significantly reduced rectal temperature (initially by 0.5±0.2°C), mean skin temperature, heart rate and sweat rate. Mid-cooling increased expired air volume and respiratory exchange ratio. Decreases in forehead temperature, thermal sensation and post-exercise blood prolactin concentration were observed in each condition.
Discussion
Running performance was improved by equal magnitude in both MID and ALL while PRE had little or no influence, despite reducing markers of cardiovascular strain. Hence, endurance athletes should focus on cooling during exercise. Mid-cooling may have improved performance through an attenuated inhibitory psychophysiological response to the heat.

ENDOGENOUS AND EXOGENOUS HEATING HAVE DIFFERENT EFFECTS ON THE SWEAT GLANDS ION REABSORPTION RATES

GERRETT, N.1, AMANO, T.2, HAVENITH, G.3, INOUE, Y.4, KONDO, N.1

1 LAHP (KOBE, JAPAN), 2 FOFE (NIIGATA, JAPAN) 3 EERC (LOUGHBOROUGH, UK) 4 LHPR (OSAKA, JAPAN)

Introduction
Upon stimulation, the sweat glands produce an isosmotic fluid in the proximal secretory coil that then travels through the distal duct towards the skin surface. To prevent excess ion loss, the distal duct reabsorbed these ions (notably Na+) (Sato et al. 1989) but the rate of ion reabsorption is limited. Plotting the relationship between sweat rate (ΔSR) and galvanic skin conductance (ΔGSC) can identify the ion reabsorption rate by observing the ΔSR threshold for an increasing ΔGSC (Amano et al. 2015). This study aims to compare the influence of endogenous and exogenous protocols on maximum ion reabsorption rates of the sweat glands.
Methods
In a repeated measures cross over randomised design, 12 participants (21.7±3.0 yrs, 59.4±9.8 kg, 166.9±10.4 cm and 47.1±7.5 ml/kg/min) visited the laboratory on 2 separate occasions for a 30-mins trial. Trials consisted of an endogenous protocols; cycling at 60% VO2max (EX) and an exogenous heating trial; passive heating with leg water immersion at 43°C (PH). Oesophageal temperature (Tes), skin temperature (Tsk) and SR and GSC were measured at the forearm, chest and lower back.

Results
A significant effect of condition was observed as EX resulted in a higher ΔSR threshold for an increasing ΔGSC compared to PH (mean value of three sites of the body: 0.80±0.41 vs. 0.58±0.37mg/cm2/min, p<0.05). The back (0.85±0.48 mg/cm2/min) had a higher threshold than the forearm (0.54±0.32 mg/cm2/min, p<0.05) but it was not different to the chest (0.67±0.34 mg/cm2/min, p>0.05). There were no differences between chest and forearm (p<0.05). Tes and mean Tsk were different between conditions but body temperature (Tb) and local Tsk at the forearm, chest and back were not different (p>0.05). Local Tsk was not different between conditions except between the forearm and back during PH (p<0.05).
Discussion
Exercise appears to have an influence on the sweat glands maximum ion reabsorption. As thermal responses (Tb and local Tsk) were similar between EX and PH suggests that sweat glands maximum ion reabsorption rates may not be influenced by thermal mechanisms. Influencing factors may result from different sympathetic responses to passive heating or exercise, including the release of water regulating hormones (e.g. aldosterone). In support of previous research the back had a higher maximum reabsorption rate than the forearm (Inoue et al. 1998) but the influence of local Tsk cannot be completely rejected and warrants further research.
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Contact
Nicola.Gerrett@gmail.com

COGNITIVE FUNCTION DURING EXERCISE IN THE HEAT AND THE EFFECT OF PRE-COOLING

SALDARIS, J.M., LANDERS, G.J., LAY, B.S., ZIMMERMANN, M.
THE UNIVERSITY OF WESTERN AUSTRALIA

Introduction
Cognitive function is the performance in objective tasks that require conscious mental effort (Taylor et al., 2016). Exercise and heat stress can deplete neural resources, leaving less attention to perform cognitive tasks efficiently (Hocking, 2001). Athletes aim to achieve and maintain an alert and vigilant state to incoming stimuli and need to be ready to respond quickly, thus attention allocation and monitoring is crucial to athletic performance (Sun et al., 2012). The aim of this study was to determine if pre-cooling via crushed ice ingestion has an effect on choice reaction time during moderate exercise in hot and humid conditions.
Methods
Ten healthy males (age 23±3 y; height 176.9±8.7 cm; body-mass 73.5±8.0 kg; VO2peak 48.5±3.6 mL·kg·min-1) commenced a 30 min pre-cooling period, ingesting either 7g·kg-1 of crushed ice or room temperature water. After which, participants cycled for 1 h at 55% VO2peak in a climate chamber set to hot, humid conditions (35°C; 60% Relative Humidity). A choice reaction time (CRT) task was completed prior, during and post the steady state cycle.
Results
There was a significant improvement in CRT (p<0.001) throughout the protocol, however this was not based on condition (p=0.329). Crushed ice ingestion significantly reduced core temperature (Tc; -0.9±0.3°C; p<0.001), remaining significantly lower than control until 25 min of exercise and again at 60 min of exercise and 5 min post. Pre-cooling also decreased forehead temperature (Tfh; -0.84±0.31°C; p<0.001) remaining significantly lower than control until 20 min of exercise.
Discussion
The 60 min moderate intensity exercise protocol in hot and humid conditions improved CRT, with crushed ice ingestion offering no further benefits to cognitive performance for the simple task. As crushed ice ingestion offered physiological benefits such as effectively lowering Tc and Tfh, further investigation is required utilising a more complex cognitive task and longer exposure to the heat.
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jacinta.saldaris@uwa.edu.au

EXERCISE TRAINING IN THE COLD ENHANCES CEREBROVASCULAR FUNCTION MORE THAN TRAINING IN THERMONEUTRAL ENVIRONMENT

MILLER, G.D., GEORGE, K.P., CABLE, N.T., LOW, D.A., JONES, H.
LIVERPOOL JOHN MOORES UNIVERSITY

Introduction
Cerebrovascular function declines with age and is linked to increased cerebrovascular disease and cognitive impairment. The mechanisms that control cerebrovascular function (e.g. reactivity to changes in carbon dioxide (CO2)) are positively associated with aerobic fitness (Bailey et al., 2013) and exercise training can improve these mechanisms in young and old individuals (Murrell et al., 2013). Both acute moderate intensity exercise and cold stress causes an increase in CBF (Murrell et al., 2013; Wilson et al., 2002). The aim of this study was therefore to investigate whether the combination of exercise training in a cold environment could maximise the effects of training on cerebrovascular function. We hypothesised that cold stress induced elevations in CBF might magnify the exercise-induced increases and subsequently accentuate cerebrovascular function.
Methods
Sixteen healthy individuals (age 22±5yrs) were randomly allocated to 8 weeks of cycling exercise at 70% HRmax in either a cold (5oC, n=9) or a thermoneutral (15oC, n=7) environment for 50 minutes 3 x per week. Before and after the 8-week intervention middle cerebral artery (MCAv), end tidal partial pressure of CO2 (PETCO2), mean arterial pressure (MAP) and cerebral reactivity to CO2 (rebreathing gas concentration of 5% CO2) were assessed alongside cardiorespiratory fitness. Data were analysed using linear mixed modelling.

Results
There was a 98% adherence to exercise training. Cardiorespiratory fitness (thermoneutral: 2.39±6.65ml.kg.min-1 vs cold: 3.41±3.92 ml.kg.min-1, P=0.06) and resting heart rate (61±9 to 56±6beats.min-1 vs cold: 59±9 to 55±6beats.min-1, P=0.05) improved similarly following both interventions. Basal MCAv (thermoneutral: 65.2±12.2 to 65.7±11.8cm.s-1 vs cold: 64.6±6.1 to 62.4±5.9 cm.s-1), PETCO2 (thermoneutral: 35.6±3.4 to 36.8± 3.7mmHg vs cold: 35.8±5.6 to 38.7±2.3mmHg) and MAP (thermoneutral: 83±5 to 81±6mmHg vs cold: 82±6 to 81±7mmHg) did not change following training. The reactivity of MCAv to CO2 was enhanced by 0.05±0.12 cm/s/Torr CO_2 following cold compared to -0.01±0.11 cm/s/Torr CO_2 following thermoneutral exercise training (P=0.009).
Discussion
These novel findings suggest that exercise training in the cold elicits greater training related improvements in cerebrovascular function. Therefore adding cold exposure during exercise could be a potential strategy for individuals with impaired cerebrovascular function.
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Invited symposia

IS-BN04 RESIDUAL FORCE ENHANCEMENT - AN UNDERRATED NEUROMUSCULAR PROPERTY FOR SPORT & HEALTH

RESIDUAL FORCE ENHANCEMENT - THE NEGLECTED NEUROMUSCULAR PROPERTY IN SPORT AND HEALTH

HERZOG, W.
UNIVERSITY OF CALGARY

Following an active lengthening contraction while maintaining activation constant, isometric force is elevated above that of a purely isometric contraction at the same final muscle length. This property of skeletal muscle is referred to as residual force enhancement (RFE) but the contractile mechanisms of RFE are still highly-debated and RFE has never been incorporated into the cross-bridge theory of muscular contraction. However, from an applied perspective there is ample evidence for RFE to exist in in vivo human muscles activated by voluntary neural drive. Accordingly, this talk will provide an overview on the phenomenological history-dependent RFE properties as observed in numerous experiments on human muscles which include voluntary contractions ranging from small hand muscles up to coordinated multi-joint contractions at maximal and submaximal activation levels. In the first part the characteristics of RFE will be described in the context of the force-length and force-velocity properties of skeletal muscles and how RFE might be influenced by muscle architectural changes. Secondly, it will be shown that RFE during voluntary contractions is not necessarily purely mechanical in nature, but also influenced by neural control in terms of more efficient activation and increased excitability with a potential of saving metabolic energy. Finally, unresolved issues and important future directions for research on RFE in the context of human motor control will be highlighted.

THE STRETCH-SHORTENING-CYCLE REVISITED: HOW RESIDUAL FORCE ENHANCEMENT CONTRIBUTES TO INCREASED PERFORMANCE.

HAHN, D., SEIBERL, W.
FACULTY OF SPORT SCIENCE, RUHR-UNIVERSITÄT BOCHUM; FACULTY OF SPORT & HEALTH SCIENCE, TECHNICAL UNIVERSITY OF MUNICH

The stretch-shortening cycle (SSC) occurs in most everyday movements as well as in many sports manoeuvers, and is thought to provoke a performance enhancement of the musculoskeletal system. However, underlying mechanisms remain a matter of debate. Although as yet largely neglected or questioned, within this talk we will show that mechanisms of stretch-induced increase in steady-state force, referred to as residual force enhancement (RFE), indeed have the potential to contribute to increased performance during SSCs. We will present recent studies on various SSCs contractions designed to rule out other potentially enhancing mechanisms like activation dynamics, stretch reflexes and series elasticity of the muscle tendon complex. The results of these studies reveal a remnant RFE after the shortening phase of SSC contractions. As the studies were designed to eliminate or minimize traditional mechanisms to explain performance increase, RFE is thought to be activated during stretch and to account for increased performance during the shortening phase of SSCs. This may change the view on the relevance of RFE in the context of sports performance. As an example, titin, the giant protein that is strongly associated with the occurrence of RFE, seems to adapt to specific muscle action of e.g. weightlifters or sprinters compared to non-athletes. Taken together, this suggests a potentially beneficial role of RFE for sports performance, which however has to be further elucidated and verified.

ACUTELY AND CHRONICALLY ALTERED NEUROMUSCULAR STATES INFLUENCE RESIDUAL FORCE ENHANCEMENT

POWER, G.,A.
COLLEGE OF BIOLOGICAL SCIENCES, UNIVERSITY OF GULEPH

Mechanisms of altered neuromuscular function can be divulged by using acutely and chronically adapted states; including muscle fatigue/damage and natural adult aging. Following active lengthening of muscle, force reaches an isometric steady state above that which would be achieved for a purely isometric contraction at the same muscle length. This fundamental property of muscle, termed residual force enhancement (RFE), cannot be predicted by the force-length relationship, and is unexplained by the cross-bridge theory of muscle contraction. In the case of muscle fatigue/damage RFE appears to increase – indicating a prophylactic effect of muscle lengthening on maintaining neuromuscular function. Similarly, natural adult aging is associated with impaired neuromuscular performance, however, strength during lengthening muscle actions is maintained better than isometric. Recently, we showed that older adults experience higher RFE than young for the ankle dorsiflexors primarily owing to a greater reliance on passive force enhancement (PFE) and similar RFE for the knee extensors but a greater contribution of PFE to total RFE. Additionally, we observed a positive association between maintained strength during active lengthening in old age and RFE. Hence, natural adult aging may prove a useful model in exploring the

active and passive mechanisms of RFE which may reside in the dissipation of force transients following stretch. A series of experiments will be presented to characterize the phenomena of RFE across various muscle groups, changes in muscle architecture, and alterations to RFE following resistance training.

Oral presentations

OP-PM18 Coaching of athletes

THE DETERMINANTS OF A GOOD LUNGE PERFORMANCE IN FENCING

CORRÊA, S.C.1, ORSELLI, M.I.V.3, XAVIER, A.P.2, SALLES, R.1, CID, G.L.2, GUIMARÃES, C.P.2

1: UPM (SÃO PAULO, BRAZIL), 2: INT (RIO DE JANEIRO, BRAZIL), 3: UNIFRA (RIO GRANDE DO SUL, BRAZIL)

Introduction
Lunge is the basis of most attacking motions in fencing and thus a well-executed gesture can be determinant to a successful attack. Our goal was to explore biomechanical parameters determinant of a good performance, and common to a group of experienced athletes. Our approach took, primarily, into account the judgment of the individual performance established by an experienced coach.
Methods
Five fencing athletes from the Brazilian Olympic Team were analysed. The subject performed an attack – lunge, from a static en garde position while being observed by a fencing coach, also part of the Olympic Team. 39 retro-reflective markers trajectories were captured with an Optitrack digital motion system (Prime 13) using eighteen cameras (sampling rate: 240Hz). Just the two best and the two worst rated (BR and WR, respectively) trials of each athlete were used in our analysis. We calculated kinematic variables of body and front-foot center of mass (CM) and the relative position of the body CM projection in the support base. Visual 3D and Matlab softwares were used. Wilcoxon signed-rank test was performed to determine the difference, for each variable (significance level of 5%). For each variable, we calculated the Z-score (Corrêa et al., 2016). We considered relevant differences for which Z-Score were greater than 2.0.
Results
Wilcoxon test did not revealed significant differences in any of the selected variables when comparing the BR and WR trials. However the Z-score for the group exceeded the value of 2.0 , for the variables: Maximal body CM forward velocity; Mean body CM forward acceleration during front-leg swing initiation; Front-Leg Stride Length ; Maximal front-foot CM forward velocity; Maximal front-foot CM downward velocity; Body CM relative position in support base at front-foot heel contact.
Discussion
No single variable was able to distinguish, for all the athletes, BR and WR trials, according to coach criteria. Such result reinforces the idea that each athlete impress in the gesture its own pattern (Gholipour et al., 2008; Klauck & Hassan, 1998). However, coach perception of a poor performance, includes lower lunge forward velocity and smaller step length. We observed that front-foot maximal forward and downward velocities were 7.5% higher in the BR trials. Thus, proper coordination between trunk, as well as upper and lower limb joint movement is necessary to increase front-foot velocity in both directions. Also the body position at front-foot heel contact can possibly be a particularly important determinant to lunge performance, as a small variation in base at this period (1.1%), resulted in relevant differences between BR and WR trials for the group.
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INTEGRATION OF PHYSIOLOGICAL AND PSYCHOLOGICAL ACTIVITY DURING FENCING COMPETITION: CONSEQUENCES ON PHYSICAL PREPARATION

DEDIEU, P., ROSNET, E., SALESSE, M., BOURDAGEAU, M., SRECKI, E., HANICOTTE, O., PHILIPPON, J.P.

FÉDÉRATION FRANÇAISE D'ESCRIME; CROIX-ROUGE FRANÇAISE; UNIVERSITÉ DE REIMS

Introduction
Characterization of physiological and psychological activity during competition is of high interest to better understand elite performance and to help to define more efficient training applications. A fencing match lasts from 3 to 9 minutes. It includes offensive and defensive patterns with repetitive forward and backward motions (Lavoie et al., 1985) allowing the final action leading to hit an opponent. These displacements need short and frequent sequences of high intensity exercises alternated with low intensity sequences allowing recovery (Bottoms et al., 2011). Moreover, the intrinsic stake of the practice, to hit without being hit, the challenge of the competition, to win the bout and the competition, solicits the psychological resources of the fencer in the same way as the muscular fatigue. In spite of isolated initiatives, knowledge about energy expenditure and the energetic requirements of fencing during competition is speculative so far, the aim of this study is to explore the possible relationships between heart rate, lactatemia and psychological states during performance in a competitive context.
Methods
37 fencers (international level) aged between 18 and 20 years old participated to the study during 6 national level competitions in U20 or adult category, one for each weapon and gender (foil, epee, sabre x male and female). Lactates were determined from 20 µl of capillary blood. Heart rate was registered all day long with a heart rate monitor. Psychological states include perceived stress, perceived activation, perceived fatigue, and perceived stake and were rated with 10 cm visual analogic scales. Measures were done when arrival on site, at the end of warm-up, before and after each match during the pool phase (only before and after the whole pool for the psychological data), and before and after each match during the direct elimination phase. A log book of the matches (time, duration, pauses, score evolution) was written for each participant.
Results and Discussion
Analyses are presented according to weapon, gender and opponent's level (rated by national and international rankings). Results confirm that competitive fencing uses wide range of energetic processes. One could be surprised at the high intensity activity whatever weapon or gender. Moreover, results show significant relationships that may highlight and reinforce the processes explaining the effi-

ciency of mental preparation techniques and physical preparation. It could explain from a different point a view some phenomenon like difficulty to gain the last hit or "fear of victory".
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A LABORATORY STUDY ON THE ATTENTIONAL BIAS AS AN UNDERLYING MECHANISM BETWEEN CORTISOL AND SPORT PERFORMANCE

LAUTENBACH, F.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
The stress hormone cortisol has been repetitively found to be negatively related to performance in sport (e.g., golf: Doan, Newton, Kraemer, Kwon & Scheet, 2007; tennis: Lautenbach, Laborde, Achtzehn & Raab, 2014). Theoretically, it has been assumed that this effect of cortisol on performance is mediated by cortisol affecting cognition during stressful and competitive situations (Lautenbach & Laborde, 2016 based on cognitive process hypothesis by Putman & Roelofs, 2011). However, to date this theoretical assumption has not been tested empirically. Therefore, the aim of this study was to investigate whether the influence of cortisol on performance is mediated by attentional processing of emotional information.
Method
Forty-six male golfers were tested in a mixed design. The cold pressor task (CPT) was used to artificially increase cortisol levels in the experimental group relative to the control group who had to put their forearm in warm water. Before and after water immersion the golfers performed one-armed 1.5 m puts and carried out the sport emotional Stroop task (Lautenbach, Laborde, Putman, Angelidis & Raab, 2016) in a counterbalanced order.
Results
Cortisol was significantly increased in the experimental group (CPT), which lead to a significant decrease in attentional bias towards negative sport words. However, no change in putting performance was observed. No mediation analyses were run, as performance was not affected due to a change in cortisol.
Discussion
Overall, findings concerning a negative association between cortisol and attentional bias were in line with the cognitive processing hypothesis (Putman & Roelofs, 2011). However, in regard to the cortisol-performance relationship, the nature of the stressor seems to play a role, as no change in performance was found due to an increase in cortisol using an artificial stressor in the current study. This is contrary to previous research that used psychosocial stressors and found connections of cortisol and performance. So far, it could carefully be concluded that the subjective appraisal of a stressor, which is arguably higher when athletes are stressed psychosocially before a competition, is relevant for sport performance rather than just a change in cortisol levels. However, as the stress response is psychophysiological in nature, future research should continue to investigate the role of cortisol.
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TRADITIONAL BASQUE ROWING: COACHES' LEADERSHIP BASED ON DIFFERENT POSITIONS WITHIN THE TEAM

LEÓN GUEREÑO, P.
DEUSTO UNIVERSITY

Introduction
Coaches' leadership according to the athletes' team position was the subject of analysis in the early 1990s as there was a supposition that the coach's required and perceived behaviours could vary depending on the athletes' different roles (Beauchamp, Bray, Eys and Carron, 2005; Gidding, 2009). In traditional Basque rowing, 14 athletes crew each "trainera" or fixed seat boat, and three different roles can be clearly identified: Cox, Strokes and the rest of the rowers (León, 2014). Inconsistent results have been found so far, probably due to the differences among various sports (Riemer, 2007). Therefore, the aim of the study is to analyse whether there were formal leadership differences among coaches or not, depending on the athletes' position within the team.
Methods
A total of four teams with their four coaches, four coxswains, eight strokes and fifty-four plain rowers participated in this study (33% of the main league). To assess the coaches' leadership, athletes completed the Spanish adaptation of the three versions of the Leadership Scale for Sports created by Chelladurai and Saleh in the early 1980s (Sánchez Bañuelos, 1996). Both rowers' preferences and perceptions about their coaches and the coaches' self-perceptions were examined at the end of the season.
Results
Some differences were observed among coxswains and the rest of the rowers in the leadership behaviour perceptions (LSS2), especially in the "permeability to opinion" dimension (p=.120). However, no statistically significant differences were observed among different positions in any of the six dimensions. The leadership behaviour preferences (LSS1) were practically the same in each role.
Discussion
The results are in line with those obtained by Çakioglu (2003) where athletes' leadership preferences (LSS1) showed no differences among positions within football teams. Leadership perceptions about their coaches' behaviours (LSS2) are only partially in consonance with some previous research carried out in several team sports (Beauchamp et al., 2005; Çakioglu, 2003; Giddings, 2009; Westre and Weiss, 1991). The structural differences among sports and different social contexts make comparison with previous research difficult (Riemer, 2007). Future studies on coaches' leadership depending on the team position and with a larger sample are needed to clarify the results obtained (León, 2014).
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Oral presentations

OP-DTB1 DTB Tennis Award 1

EVALUATION OF SILHOUETTE-BASED MARKERLESS AND HYBRID TRACKING FOR KINEMATICS IN TENNIS

FRÜHSCHÜTZ, H., RUSS, P., LIEBHARDT, M., SPITZENPFEIL, P.

TECHNISCHE UNIVERSITÄT MÜNCHEN

Introduction
"The […] monitoring of elite athletes in their […] training environment is a relatively new area of development" (James, 2006). One method for motion analysis in tennis science is marker-based tracking of the athlete. However, it involves several disadvantages (Karlsson & Lundberg, 1994; Leardini, Chiari, Croce, & Cappozzo, 2005), e.g regarding the practicability in training or competition (Mündermann, Corazza, & Andriacchi, 2006). The purpose of this study was to assess the accuracy of silhouette-based and hybrid tracking (Simi Shape) compared to marker-based tracking.
Methods
In order to quantify the accuracy of silhouette- against marker-based tracking, four different power strokes of one elite tennis player were recorded by an 8-camera motion capture system (Simi Reality Motion Systems, Munich, Germany). Correlation coefficient and SD of the differences were compared for the parameters joint angle, -center, segment center gravity of mass .
Results
All strokes show a strong correlation (r >.8) for the joint center locations as well as for the segment center of gravity locations, with a difference of up to 2 mm for segment center of gravity locations within the serve and up to 10 mm for joint center locations within the forehand for silhouette and hybrid tracking. Joint angles show maximum moderate correlation (r <.4) for silhouette tracking out of the sagittal plane but strong correlation of ankle, knee and shoulder joint angles for all strokes within the sagittal plane. Hybrid tracking increases the correlation coefficient of the knee, hip, shoulder and elbow joint in all planes for the groundstrokes.
Discussion
The study shows that all aspects of joint center and segment center of gravity positions, and thus, their velocity can be accurately measured with silhouette-based tracking. Consequently, 3-point-angles for each joint can be calculated accurately in an application-oriented research in tennis. For more scientific work concerning joint angles separated into the three body planes, additional marker information for hybrid tracking is necessary to stabilize the detected segment rotations. This orientation information of each segment can also be based on data of inertial measurement units.
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Contact
hannes.fruehschuetz@tum.de

BIOMECHANICAL ANALYSIS OF TENNIS SERVE IN YOUNG ELITE PLAYERS: EFFECT OF THE "WAITER'S SERVE" ON UPPER LIMB LOADS

TOUZARD, P., KULPA, R., BIDEAU, B., MARTIN, C.

UNIVERSITY RENNES 2

Introduction
Serve is described as the most important stroke (Johnson et al., 2006) but also the most traumatic stroke in adult elite tennis players. Joint loads must be minimized to avoid upper limb overuse injuries. A better knowledge of technical aspects of serve is essential for players and coaches. A poor serve technique increased joint loads in adult elite players and can be considered as an injury risk factor (Elliott et al., 2003; Martin et al., 2013). A particular attention must be paid to young elite players, as their bodies are developing and their serve technique is evolving. Young athletes must develop the best serve technique for limiting joint loads, avoiding overuse injuries and finally do not break a potential high-level career. The aim of this study was to analyze the effect of one technical point, the « waiter's serve position », on upper limb joint loads in young elite players.
Methods
18 young elite males (Top 10 national French ranking, age: 13.4 ± 0.8 years; height: 1.72 ± 0.08 m; weight: 59.1 ± 7.5 kg) performed 5 successful flat serves at maximum speed. Two groups were formed by experimented tennis coaches: G1 (n=10) in which players served with the « waiter's position » (racket face parallel to the ground during cocking) and G2 (n=8) in which players did not. A 16-camera Vicon MX system (200 Hz) was used for serve motion capture. Maximal upper limb joint loads were calculated with dynamic inverse method.
Results
Ball speed was not different between the two groups (G1: 162.2 ± 8.9 km/h vs. G2: 164.1 ± 11.9 km/h). Shoulder internal rotation torque (G1: 0.57 ± 0.05 Nm/kg/m vs. G2: 0.51 ± 0.04 Nm/kg/m) (p=0.02), elbow varus torque (G1: 0.59 ± 0.05 Nm/kg/m vs. G2: 0.52 ± 0.01 Nm/kg/m) (p=0.003) and wrist anterior force (G1: 3.0 ± 0.2 N/kg vs. G2: 2.7 ± 0.4 N/kg) (p=0.02) were significantly higher in G1.
Discussion
In both groups, high joint loads were found. This confirms that the serve could be a traumatic stroke for upper limb joints (Dillman et al., 1995) not only in adults but also in young elite players. Moreover, the « waiter's position » induced higher upper limb joint loads, with no

incidence on ball speed. Consequently, the « waiter's position » can be considered as a pathomechanical factor in young elite players, and could lead to upper limb joint injuries.

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Contact
pierre.touzard@hotmail.fr

RELATIONSHIPS BETWEEN ANTHROPOMETRIC OR FUNCTIONAL CHARACTERISTICS AND MAXIMAL SERVE VELOCITY IN PROFESSIONAL TENNIS PLAYERS

BONATO, M., ROSSI, C., MERATI, G., LA TORRE, A.
UNIVERSITÀ DEGLI STUDI DI MILANO

Introduction
In the last decades, tennis serve has become one of the most important shots of tennis game, allowing players to gain points with no or very short rallies. In fact, as shown by ATP data, in 2015 51 players obtained more than 70% of points during the first serve. This study aims at investigating the possible relationships between anthropometric and functional parameters and maximal serve speed in professional tennis players.
Methods
Eight professional male tennis players (age 23±4 [mean±SD] years-old; height 181±4 cm; body mass 80±4 kg; playing experience 14±4 years; training practice29±6 hours/week) were recruited. Anthropometric parameters, squat jump, counter movement jump, counter movement jump free (4-Jump, Kistler Instruments, SWI), handgrip strength (Irvington, NY, USA), string tension and first and second maximal serve speed (Stalker Radar, Texas, USA) were assessed. Height jump during first and second serve (Optojump Next, Italy) was also evaluated.
Results
Pearson's correlation coefficient showed significant ($p<0.05$) positive relationships between height and ball speed in both the first ($R=0.78$; $p=0.02$) and second ($R=0.80$; $p=0.017$) serve. Significant negative correlation between negative correlation between serve speed and arm muscle area in the first serve only ($R= -0.78$; $p=0.03$) was found. Moreover, slightly significant correlation between jump height and first ($R=0.71$; $p=0.049$) and second ($R=0.71$; $p=0.047$) serve speed was computed. In addition, a trend towards a positive correlation was observed between string tension and serves for both first and second serve ($R=0.54$; $p=0.16$; $R=0.60$; $p=0.11$). No significant relationship was found between serve speed and the other variables considered.
Discussion
A proficient serve is a crucial part of tennis players' stroke repertoire and it can be used to gain an advantage at the start of each point. Height was confirmed to be the main anthropometric determinant of serves speed in professional players and it could be a prerequisite for success in this sport. Moreover, reaching higher impact point with a vertical contribution of the lower limbs could improve the chance to realize a fast serve. However, tennis players must to take in account that trying to develop higher vertical forces for improve jump height during first and second serve could be counterproductive because serve technique requires the coordination of both lower and upper limbs.

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Contact
matteo.bonato@unimi.it

POST-ACTIVATION POTENTIATION IN TENNIS SERVE

TERRAZA REBOLLO, M.
UNIVERSITAT DE BARCELONA

Introduction
The acute effect due to the physical activity can cause fatigue inducing a decrease of the strength and power. In contrast to this effect, it can happen the Post-Activation Potentiation (PAP). Nowadays, it is not known that the PAP effects in the tennis player performance.
Methods
12 young tennis players (age, 15.9 ± 1.5 years; height 173,8 ± 8,4 cm; body mass 64,2 ± 10,5 kg) participated in a cross-study. They performed 4 speed serve test in 4 different days, 3 test with different conditioning activities and 1 test without conditioning activities. The conditioning activities were squat, bench press or both, 2 or 3 sets doing 3 reps at 80% of 1RM. The test consists in 4 sets of 8 flat serves (4 each side) at maximum speed with 20 seconds of recovery between serves to avoid fatigue. The first set was registered just after the conditioning activities, the second set 5 minutes later, the third set 10 minutes later and the fourth set 15 minutes later. Peak ball velocity was measured in real time by a radar gun (R 3600, Sports-radar, Homosassa, FL, USA). All subjects performed the same warm-up (4 minutes running, footwork, joint mobility, elastic exercises, 10 movement serves and 10 submaximal serves), after they performed the conditioning activities and then the serve speed test. One of the four tests was accomplished without the conditioning activities and this was the basal situation.
Results
There were no significant differences in any of the four cases (0, 5, 10 and 15 minutes later) in comparison to the basal situation. However, there was a slight tendency towards increasing the serve speed between the minute 5 and 10 after bench press and after squat, but not after bench press and squat being done together. In addition, there was a slight tendency with statistically no significant results towards decreasing the speed just after the conditioning activities.
Discussion
Our findings show that bench press and squat did not improve the speed serve in tennis. It is possible that there is no significant increasing in the serve speed because bench press and squat did not have an impact on the kinetic chain muscles of tennis serves or that the protocol could affect more the fatigue than the PAP. The protocol was designed following the results of the meta-analysis of Wilson et al.

(2015), but this guideline could not be useful for young people or for a complex movement like tennis serve. Tennis serve has a complex kinetic chain, the power begins in the legs, then it is transferred to the trunk and finally to the arm-racket (Elliot et a. 2003). It is possible that bench press and squat do not stimulate all the muscles needed for the tennis serve. Maybe other exercises with a complex kinetic chain could get significant increase in the serve speed.

BIOMECHANICAL PROFILE OF TENNIS MATCH PLAY: EFFECTS OF PLAYING SURFACE

PONZANO, M., GOLLIN, M.

SUISM, UNIVERSITY OF TURIN, ITALY

Introduction
The average duration of a tennis match is greater on clay compared to grass or concrete (O'Donoghue & Liddle, 1998), although the technical-tactical evolution of recent years has led to more similar playing times (Fabre et al., 2012). The average heart rate, the rally duration, the total distance and the distance run in each single point are greater on clay than on hard courts, while there are no surface-related differences concerning oxygen consumption (Murias et al., 2007). Therefore, the aim of this study was to examine biomechanical parameters of real tennis matches, also analysing potential surface-related differences.
Methods
Twenty-four matches played by twelve athletes (age 16±3 years, height 179±6cm, weight 69±11kg, years of competitive experience 9±3 and 5±2 training sessions each week) were analysed. Each participant played two matches: one on clay and one on a hard court, with a counterbalanced design. During matches, players were equipped with a 15Hz GPS SPI HPU device and a Polar H7 heart rate sensor. The parameters of speed (SP), heart rate (HR), acceleration (ACC) and deceleration (DEC) were examined calculating the percentage of the total time spent in each intensity threshold or the number of events performed.
Results
The average duration of matches was 76±24 and 69±17 minutes on clay (C) and on hard courts (H) respectively. The maximum heart rates (HRmax) were 185±14 (C) and 178±10 bpm (H), the average heart rates (HRav) were 144±14 bpm (C) and 139±12 bpm (H). The ANOVA and the post hoc showed significant differences regarding the considered parameters on both the surfaces. The t-test highlighted significant surface-related differences ($p < 0,05$, C > H, +26%) concerning accelerations performed between 50% and 60% of the maximum value and decelerations between 40% and 50% of the maximum ($p < 0,05$, H > C, +37%).
Discusison
The playing surface affects almost none of the considered parameters. On the other hand, on the same kind of court, many differences between the various intensities are present. These results are in keeping with Hoppe et al. (2016), which demonstrated that adults perform more accelerations greater than 4 m x s-2 and decelerations lower than -4 m x s-2 compared to adolescent players.
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SYSTEMATIC GAME OPENING ANALYSIS AT TOP LEVEL IN MEN'S TENNIS – APPROACHING A NEW COURT-DIVISION METHOD

BORN, P., WEBER, K., GRAMBOW, R., MEFFERT, D., VOGT, T.

GERMAN SPORTS UNIVERSITY COLOGNE

Introduction
An outstanding game opening (serve and third stroke) is a decisive element to being successful in modern Men's Tennis and its importance is well accepted. However, a systematic game opening analysis remains to be elucidated. Therefore, the present study applied a new examining tennis-court-division method.
Methods
For this, randomly selected matches of both the 2010 US Open and the 2012 French Open (in each tournament six matches of the last 16, four quarter-, two semi-finals and the final) compiled a sample of 24871 strokes and 3553 serve patterns (SP) for analysis. Single strokes were analysed regarding stroke selection and placement, SP regarding its frequency of use and success rate. The applied examining method allowed for a detailed analysis of the game opening strokes and tactics by dividing the court into 20 zones as well as connecting serve and third stroke.
Results
The top-3 SP in the aggregated ranking of frequency and success rate are i) serve wide – 3rd stroke same corner, ii) serve to the T – 3rd stroke free corner and iii) serve wide – 3rd stroke free corner, which, according to their success rate, were larger than 66% and, thus, more successful than the average ($p<0.001$). Winners (W) play their SP more successful than losers (L; $p<0.001$). SP with run around forehands were more successful than SP without ($p<0.01$). Within the SP most first (70.3 ± 12.0% won, W $p<0.001$) and second serves (51.7% ± 13.3% won, W $p<0.001$) were targeted to the backhand. Regarding the third stroke the forehand and especially the run around forehand were played most often ($p<0.001$). 66.0% ± 10.4% were hit into the outer zones and more often by W ($p<0.01$), 39.8% ± 10.6% into the outer zones of the backhand (W $p<0.01$), and 34.9% ± 11.8% into the c-zones (W $p<0.05$), which are located at the side-lines directly behind the service line.
Discussion
Serve directions and winning percentages confirm well-reported coaching-demands, and mark a difference between winning and losing. The increased use of the forehand at the third stroke as well as the numbers for the placement of the third stroke support previous findings. Most important factors are the placement into the outer zones (of the backhand) and into the c-zones. The SP analysis confirms existing concepts and substantiates empirically for the first time that there are four main SP that are played by W and L; however, W play theirs more successful (again the use of the forehand is a succeeding factor). To conclude, placing the strokes in specific zones of the court and the use of the forehand in the game opening are key to playing the SP successful and winning matches in general.

Oral presentations

OP-BN05 Injury prevention

REGION-DEPENDENT HAMSTRING MUSCLE ACTIVITY IN COMMON REHABILITATION EXERCISES

HEGYI, A., CSALA, D., PETER, A., FINNI, T., CRONIN, N.J.
UNIVERSITY OF JYVÄSKYLÄ

Introduction
Hamstring injuries are the most common type in many sports e.g. in football (Ekstrand et al., 2016). Loss of strength seems to be the most significant risk factor (van Beijsterveldt et al., 2013), so optimising exercise selection is of major interest. Recent studies implied that different hamstring exercises preferentially increased metabolic activity in different regions of the hamstrings (e.g. Mendez-Villanueva et al., 2016). However, the neural representation of this phenomenon is unknown. This study examined whether hamstring electrical activity differs proximo-distally, and if relative recruitment of the regions varies in common rehabilitation exercises.
Methods
Eleven amateur football players without history of hamstring injury performed 9 different hamstring exercises with a load of 12 repetition maximum. Activity of the biceps femoris (BF) and semitendinosus (ST) muscles were recorded using 15-channel high-density electromyography arrays. Root-mean-square activity in each exercise was determined in the distal, middle, and proximal regions of each muscle and normalised to the maximal voluntary isometric contraction (MVC). Mean activity and relative contribution of ST and BF were also calculated. Repeated measures ANOVA with Bonferroni correction was used to determine differences. Significance level of p was set at 0.05.
Results
On average, proximal activity in BF was 10% lower than in middle or distal, while in ST the distal region showed 16% lower activity than the other regions ($p < 0.02$ in all). The relative contribution of muscles or regions did not differ significantly between the exercises. Slide leg curl (59±5%MVC) and straight leg bridge exercises (58±18%MVC) produced the highest activity of all exercises.
Discussion
Novel methodology applied to hamstrings revealed proximo-distal differences in muscle electrical activity. In BF, EMG activity was lowest in the proximal region, which also seems to be the most vulnerable injury site (Wangensteen et al., 2016). ST and BF muscles showed different patterns in terms of preferentially activated regions, highlighting the need for a holistic approach when the activity of these muscles is studied. However, contrary to previous studies on metabolic activity, the relative electrical activity of muscle regions did not differ between different exercises. Thus, preferential recruitment of muscle regions does not seem to be exercise-dependent.
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andras.a.hegyi@jyu.fi

BALANCE IN HAMSTRING MUSCLES STIFFNESS AMONG ELITE ATHLETES

AVRILLON, S., LACOURPAILLE, L., FREY, A., LE SANT, G., NORDEZ, A., HUG, F., GUILHEM, G.
FRENCH INSTITUTE OF SPORT (INSEP), LABORATORY SPORT, EXPERTISE AND PERFORMANCE (EA 7370), PARIS, FRANCE

Introduction
Muscle stiffness and strength ratios are considered as predisposing factors of hamstring injury (Opar et al., 2012). However, recent research programs failed to show any relationship between these factors and injury incidence (van Dyk et al., 2016). Thus, the development of a localized evaluation method would allow to focus on muscles revealing high prevalence of injury. The aim of the present prospective study is two-fold: i) to determine whether passive muscle stiffness is homogeneous within hamstring muscle group, ii) whether elite sport practice is associated with passive hamstring stiffness.
Methods
Shear modulus was measured on semitendinosus (ST), semimembranosus (SM), biceps femoris (BF) using shear wave elastography in 74 elite athletes from athletic sprinting, taekwondo, fencing, field hockey and soccer with the knee flexed at 60 and 90° (0°=full extension). Strength ratio were measured on an isokinetic dynamometer (Croisier et al., 2008).
Results
A significant effect of sport ($p=0.006$), muscle ($p<0.001$) and an interaction sport × muscle ($p=0.006$) was found on hamstring shear modulus. Overall, BF was stiffer (15.6±8.5 kPa) than SM (14.6±9.1 kPa $p=0.027$) and ST (11.2±6.3 kPa $p<0.001$) muscle. Regardless of the muscle, shear modulus was higher in fencers (15.2±4.1 kPa) and field hockey players (17.1±3.0 kPa) compared to taekwondo practitioners (11.1±1.5 kPa). No significant effect of sport was observed on strength ratios ($p>0.25$).
Discussion
Our findings suggest that chronic practice may elicit long-term changes in hamstring mechanical properties in elite athletes. In addition, BF is stiffer compared to synergistic hamstring muscles (ST, SM). The high prevalence of strain injuries on BF could at least partly be related to this higher stiffness among hamstring muscles. Shear wave elastography could be useful to assess these mechanical properties in a view to determine injury predisposing factors.
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Contact
simon.avrillon@insep.fr

THE EFFECT OF STRIDE LENGTH MANIPULATION ON LOADING IN HABITUAL RUNNERS: A CASE STUDY

DOYLE, S., DISS, C., BRUTON, A.
UNIVERSITY OF ROEHAMPTON

Introduction
A large running population combined with high injury rates has developed a need for proactive methods to reduce injury risk. Gait-retraining (GR) interventions using stride length (SL) manipulation have shown success in reducing lower-limb loading (Barton et al., 2016), particularly for the vertical ground reaction force impact peak (GRF). A case study was used to highlight individual responses to GR (Davis, 2005; Thelen et al., 1994) with the aim to assess the impact of a four-week intervention on SL reduction and subsequent biomechanical changes in two habitual runners.
Methods
Two habitual runners experiencing knee pain, completed eight GR sessions aiming to reduce SL by 2-4% (Moore, 2016) over a four-week period. Biomechanical measures and knee pain were initially assessed and were compared to results obtained in post- intervention. Verbal, auditory and visual feedback regarding SL was provided during the first four GR sessions before verbal and auditory feedback were removed for sessions five to eight. For the discrete measures percentage differences were determined between data sets pre and post intervention and Hedge's g reported the effect size. One-dimensional statistical parametric mapping (1D-SPM) was used to assess significant differences in the vertical and horizontal GRF throughout stance between pre- and post-testing (Pataky, 2012).
Results
Participant 1 (P1) achieved SL reduction of 2.6% resulting in substantial reductions in the majority of loading measures, including a 9% reduction in vertical GRF impact peak ($p<0.001$ via 1D-SPM) and knee pain was reduced by 24.5%. Participant 2 (P2) did not achieve the required SL reduction, achieving a 1.3% reduction, which lead to increases in loading measures (vertical GRF impact peak by 1.9%) and knee pain (by 28.6%) following GR.
Discussion
A reduction of SL, within the desired range, produced positive changes regarding lower-limb loading and knee pain (Barton et al., 2016). However, a SL reduction of only 1.3% produced notably different results as loading variables and knee pain increased following GR. Opposite responses between P1 and P2 were seen in biomechanical loading measures (Heiderscheit et al., 2011) which suggested that P2 needed to continue with GR until the desired reduction in SL had been achieved. The highlighted individual responses of habitual runners to GR, endorses a more individual approach to injury prevention training.
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Contact
simon.doyle19@gmail.com

IMPACT FORCES DURING JUMP LANDING: DOES SPORTS FLOORING MATTER?

MALISOUX, L., GETTE, P., THEISEN, D.
LUXEMBOURG INSTITUTE OF HEALTH

Introduction
High impact forces have been associated with increased risk of injury in running and other sports. The concept of cushioning has been used for several decades in footwear engineering in an attempt to reduce impact forces. Sports flooring is another material influencing impact forces during landing. Surprisingly, very little information is available on the effect of sports flooring properties on human biomechanics during jumping exercises. The main purpose of this study was to determine the influence of different sports floorings, as well as sports shoes, on impact forces during a conventional standardised jump task.
Methods
Healthy young men (n=21) accustomed to eccentric exercises performed several series of multi-jump (3 series per condition) landing on force plates. The tests were performed in both minimalist and cushioned shoes and were repeated in 5 flooring conditions, administered in random order. Shock absorption properties (expressed in %) of the sports floorings (SF) were: SF0=0% (no flooring), SF1=19%, SF2=26%, SF3=37% and SF4=45%. Participants were asked to jump as high as possible, with jump height computed by double integration of the centre of mass vertical acceleration. Shoe and flooring effects were compared using 2x5 two-way analyses of variance for repeated measures with the post hoc Bonferroni correction and pairwise comparisons. Accepted significance was set at $p<0.05$.
Results
Shoe type influenced impact forces at landing, with cushioned shoes generating lower peak vertical ground reaction force (PVGRF, $p<0.001$, 95%CI: -4.20 to -2.20 N/kg), lower maximal vertical instantaneous loading rate (VILR, $p<0.001$, 95%CI: -979 to -627 N/s/kg) and shorter contact time (CT, $p=0.002$, 95%CI: -0.039 to -0.009 s) when compared to minimalist shoes. No difference between shoe conditions were observed for vertical average loading rate (VALR, $p=0.488$) and eccentric work (Wecc, $p=0.792$). Floorings influenced VILR ($p<0.001$) and CT ($p=0.013$). Post-hoc analyses showed that VILR was significantly lower in SF4 when compared to SF0 ($p<0.001$, 95%CI: -1108 to -306 N/s/kg) and SF2 ($p=0.002$, 95%CI: -932 to -130 N/s/kg). VILR was also lower in SF3 when compared to SF0 ($p=0.012$, 95%CI: -865 to -63 N/s/kg). Also, CT was shorter in SF2 when compared to SF1 ($p=0.004$, 95%CI: -0.077 to -0.009 s). No significant effects of floorings were observed on PVGRF ($p=0.240$), VALR ($p=0.802$) and Wecc ($p=0.380$).
Discussion
Shoe type largely influenced most of the landing related variables. Additionally, VILR was influenced by sports floorings, the softest floorings showing the lowest VILR at landing. These results could have important consequences regarding injury prevention, as some sports injuries have previously been associated with VILR.

CAN SHOE CUSHIONING REDUCE SHOCK AND AFFECT MUSCLE ACTIVATION DURING DIFFERENT LANDINGS?

FU, W., MAO, L., LIU, Y.
SHANGHAI UNIVERSITY OF SPORT

Introduction
The drop jump, regarded as "an active landing from a self-initiated drop" (SIDL), is an effective training modality to develop explosive / reactive strength and attenuate landing shocks after touchdown (Bobbert et al., 1987; Horita et al., 2002). Contrarily, "a landing from an unexpected drop" (UDL), which is mostly unanticipated, has been proposed to generate potentially detrimental alterations to impact absorption and lower extremity configuration during dynamic sports postures (Borotikar et al., 2008). To date, few rigorous scientific studies have been conducted to understand the impact mechanics and muscle activation characteristics of these two landing tasks and the influence of shoe properties. The purpose of this study, therefore, was to investigate the effects of different footwear on impact, muscle activity (pre- and post-activation), and their possible interactions during bipedal landings from self-initiated and unexpected drops.
Methods
Twelve male collegiate basketball players performed bipedal landings from self-initiated and unexpected drops (SIDL and UDL) from a 60-cm height wearing highly-cushioned basketball shoes (Bball) and less cushioned control shoes (CC). Sagittal plane kinematics, ground reaction forces (GRF), accelerations of the shoe heel-cup, and electromyography (EMG) of the tibialis anterior (TA), lateral gastrocnemius, rectus femoris (RF), vastus lateralis (VL), and biceps femoris (BF) were collected simultaneously.
Results
In SIDL, no significant differences were observed in peak vertical GRF, peak heel acceleration, or EMG amplitude (root mean square, EMGRMS) for all muscles between the two shoe conditions. In UDL, however, both peak vertical GRF and heel acceleration were significantly lower in Bball compared to CC. Furthermore, the EMGRMS of TA, RF, VL, and BF muscles showed a significant decrease in Bball compared to CC within the 50 ms after contact.
Discussion
During active landings from self-initiated drops, participants landed with a more flexed hip and knee, and shoe cushioning did not significantly change the impact characteristics or muscle activity patterns. This suggests that shoe cushioning may have only a limited role in reducing the impact provided appropriate neuromuscular adjustments occur properly during pre-planned movement tasks (e.g., self-initiated drop jumps). However, in landings from unexpected drops, where muscle activation is lower shortly before and after ground contact, participants landed with a more erect posture and wearing a highly-cushioned shoe decreased peak impact and muscle post-activation. Potentially, this beneficial effect of footwear may be further developed for preventing impact-related injuries during unanticipated landings or whilst in a fatigued condition.
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Oral presentations

OP-PM63 Methods in exercise physiology 2

MITOCHONDRIAL OXYGEN AFFINITY AND ITS ROLE IN DETERMINATION OF MAXIMAL OXYGEN CONSUMPTION

CARDINALE, D.A., LARSEN, F.J., JENSEN-URSTAD, M., RULLMAN, E., SØNDERGAARD, H., MORALES-ALAMO, D., EKBLOM, B., CALBET, J.A.L., BOUSHEL, R.
THE SWEDISH SCHOOL OF SPORT AND HEALTH SCIENCES (GIH) (STOCKHOLM, SWE)

Introduction
Maximal oxygen consumption (VO2peak) is limited primarily by oxygen (O2) delivery during exercise engaging a large fraction of muscle mass. The physiological significance of muscle mitochondrial excess capacity (OXPHOS) in the O2 cascade in humans is unknown, but may involve the regulation of diffusional O2 conductance and extraction by mitochondrial O2 affinity (p50mito). We examined the role of p50mito for defining O2 diffusion, O2 extraction, and O2 uptake during exercise with large and small muscle mass during normoxia (NORM) and hyperoxia (HYPER).
Methods
Seven endurance trained individuals performed two incremental exercise tests to exhaustion on a bicycle ergometer (BIKE) and two on a one-legged knee extension ergometer (KE) in NORM or HYPER. Leg blood flow and VO2 were determined by thermodilution and the Fick method. OXPHOS and p50mito were measured ex vivo in permeabilized fibers and isolated mitochondria.
Results
The ex vivo p50mito increased from 0.06±0.02 to 0.17±0.04 kPa with increasing mitochondrial activation, O2 flux rates from 6.42±1.85 to 10.67±2.60 pmol O2*s-1*µg-1. Similarly, in vivo p50mito increased from 0.064±0.03 to 0.181±0.05 kPa as leg VO2 was increased from 197.7±19.3 to 333.9±56.7 ml*min-1*kg-1 in BIKE and KE, respectively. O2 extraction decreased from 83% in BIKE to 67% in KE as a function of a higher O2 delivery, relative mitochondria activation, and p50mito. Similarly, during HYPER increased p50mito to 0.081 kPa during BIKE and 0.211 kPa during KE.
Discussion
Here we show that in-vivo p50mito varies with mitochondrial activation and O2 delivery, and is a key regulator of O2 extraction during exercise. Excess capacity of muscle OXPHOS maintains a low p50mito to maximize O2 diffusion from microvessels to mitochondria independent of mean capillary PO2.

MONITORING ACUTE FATIGUE IN SOCCER PLAYERS

ALI, A., WIVELL, A., WALSH, D., FOSKETT, A.
MASSEY UNIVERSITY

Introduction

Monitoring fatigue is a key consideration when managing the workloads of elite soccer players. International players are only with their national teams for short periods of time, the team will often be playing overseas and will not have access to sophisticated monitoring equipment, and they may arrive in varying states of fatigue having flown across a number of time zones. A number of potential fatigue markers have been proposed, however, little work has been performed in order to assess the relationship between such measures and actual performance. Therefore, the aims of this study were to examine the correlation between a range of simple fatigue tests and physical performance and to develop a model by which readiness to perform could be predicted.
Methods
Fourteen soccer players (height: 177.8 ± 4.6 cm; mass: 75.1 ± 7.5 kg; estimated VO2max: 50.4 ± 3.7 ml·kg-1·min-1) completed a range of fatigue tests (countermovement jump (CMJ), functional soreness (FS), general muscle soreness (GMS), subjective wellness) and resting heart rate variability (HRV) and a performance test (3 x 30-m repeated sprint test; RSA) before and after (24, 48, and 72h post) undertaking a soccer match simulation (Loughborough Intermittent Shuttle Test; LIST).
Results
Immediately following the LIST, RSA performance (mean 30 m time, p=0.001) and CMJ height (p=0.005) were reduced whereas FS (p<0.001), GMS (p=0.002), and perceived fatigue (p=0.024) increased. HRV was reduced the morning following the LIST (p=0.017) but returned to baseline the next morning. Perceived fatigue (FTG) returned to baseline after 24h. CMJ height was recovered by 48h, whereas RSA performance remained reduced until 72h post-LIST. GMS returned to baseline after 72h but FS remained elevated. Of the fatigue measures used, only CMJ was found to be correlated with RSA performance (r=-0.402, p=0.002). Three models for predicting performance were developed which differed in their degree of individuality:
General Model equation:
RSA (Mean 30-m time) = 5.664 + (-0.0190 * CMJ) + (-0.0610 * FTG) + (-0.0935 * GMS)
Intercept Model equation:
RSA (Mean 30-m time) = 5.462ã + (-0.0164 * CMJ) + (-0.0748 * FTG) + (-0.0890 * GMS)
Individual Slope Model equation:
RSA (Mean 30-m time) = 6.940ã + (-0.0446ã * CMJ) + (-0.0748 * FTG) + (-0.0890 * GMS)
ã = Modified according to individual
Discussion
Individual models were found to have a greater strength than the general model. For practitioners, more work is required to develop individual models, however, subsequent predictions made about performance are likely to be more accurate than group-based predictions. Future studies are needed to refine these models in order that they might be used in practice to make decisions about readiness to train and perform.

EFFECTIVE RECOVERY AND DYNAMIC SLEEP: OBJECTIVE METHOD FOR EVALUATING TRANSIENT SLEEPING ENVIRONMENTS

TROYNIKOV, O., NAWAZ, N., WATSON, C.

RMIT UNIVERSITY

Introduction
Poor sleep affects the overall recuperative quality of the sleep state [1]. For athletes, the restorative effects of sleep are commonly acknowledged as important for physiological and psychological preparation for and recovery from participation in the sporting activities [2]. A common approach in human sleep testing is to use subjects. Significant limitation of this testing is its subjectivity and the small number of subjects [3]. The use of thermal manikins to measure thermal and vapour resistance is a standard objective method adopted for assessment of sleeping bags, bedding and sleepwear.
Methods
A dynamic experimental protocol was established in order to determine the possible impact of the different bedding systems and mattresses on sleeping microclimates, using a zoned sweating thermal manikin. An experimental cycle of different heating and sweating phases was used to simulate the sleeping human metabolic and sweating activity conditions through the sleep phases. The manikin was placed in two different experimental bedding systems in a controlled environmental chamber. Temperature and humidity in the next to skin microenvironment were dynamically measured at different sites of the manikin's body.
Results
The study found that one of the experimental bedding ensembles exhibits a higher overall bedding micro environmental temperature than the other experimental ensemble with all other variables being constant. This resulted in up to 3°C higher micro environmental temperature by the end of the experiment. The micro environmental temperature differences between the front and the back zones of the manikin for the first experimental bedding ensemble reached 2.5°C. This allowed the conclusion that there is a significant difference between micro environments produced by the different experimental bedding systems.
Discussion
The developed objective method and exploratory initial experimental results of this study suggest that it is possible to objectively identify bedding systems which provide moderate micro environmental temperature fluctuations and steady humidity profiles during the sleep cycle to enable more restful and recuperative sleep.
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MEASURE OF THE METABOLIC CAPACITIES IN SWIMMER: COMPARISON OF A STANDARD APPROACH WITH THE ENERGY MUSCLE METABOLISM SIMULATION METHOD.

HELLARD, P., RODRIGUEZ, F., MADER, A., WEBER, S.

FRENCH SWIMMING FEDERATION

Introduction
The aim of this study was to compare in 12 elite swimmers a standard approach with the muscular metabolism simulation method [4,5]. for the assessment of the oxidative capacity (VO2max), glycolytic capacity (VLamax) and speeds associated with the various thresholds (steady state threshold, 2mm.l-1, 4mm.l-1).
Methods
Twelve swimmers performed five tests during five different sessions 1) a maximal 400-m swimming test (T400max); 2) a sub-maximal 400-m swam at 80 % of T400max (400-m 80%); 3) a sub-maximal 400-m swam at 90 % of T400max (400-m 90%) 4) A maximal 100-m test (T100max), 3) a 20–s maximal test (T20-s max). The oxygen consumption was measured immediately after each test using a breath by breath gaz analyzer (K4b2, Cosmed). VO2 was derived from linear backward extrapolation method. Blood lactate concentration was measured before and 1, 3, 5 minutes after the efforts of 400-m and 3, 5, 7 and 10 minutes after the maximal efforts of 100-m and of 20 seconds.
Results
Speeds, VO2 and lactates for the three 400-m were respectively (1,15±0,11, 1,26±0,14, 1,38±0,11 m/s), (38,3±2,55 ; 44,3±4,7 ; 50,8±3,7 ml/mn/kg), (1,7±0,7 ; 2,5±0,7 ; 10,6±0,6 mmol/l). Energetic costs were 0,72±0,09 ; 0,77±0,12 ; 0,89±0,13 kJ/m. Speeds at 2 and 4 mmol/l were 1,21±0,14 and 1,28±0,13 m/s. The simulated values of VO2 tot 400-max, VO2 max 400-max, anaerobic threshold and VLamax were (72,6±3,1 ml/min/kg; 62,8±5,7 ml/min/kg, 1,28±0,13 m/s et 0,34±mmol/ll/s). Speeds corresponding to the maximal lipid consumption was 1,16±0,1 m/s (mean value). Speeds corresponding to the maximal lactate shuttling was 1,22±0,12 m/s (mean value). VO2 max 400-max measured were lower ($p<0,05$) but correlated with simulated VO2 max ($r^2=0,5$, $p<0,05$). For T400max simulated and measured VO2 max did not correlate. Conversely for (400-m 80%), simulated VO2tot correlated with measured VO2 ($r^2>0,8$, $p<0,01$). Simulated and measured speed highly correlate ($r^2>0,9$, $p<0,01$). V2mmol/l was equivalent to the maximal consumption lipid speed (1,22 m/s) and V4mmol/l was equivalent to simulated anaerobic threshold speed (1,28 m/s).
Discussion
Both approaches (lactate and VO2 backward retro-extrapolation testing method) and energy muscle metabolism simulation method provide quite similar and complementary measure. The lower values in measured VO2 can be attributed to the retro-extrapolation method accuracy.
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SUPPORT VECTOR MACHINE LEARNING TOOL FOR THE INTERPRETATION OF CARDIOPULMONARY EXERCISE TEST RESULTS

INBAR, O.1,2, GREENSPAN, H.1, REUVENI, R.2, SEGEL, M.2, SCHEINOWITZ, M.1

1.TEL-AVIV UNIVERSITY 2. SHEBA MEDICAL CENTER, ISRAEL.

Introduction
Cardiopulmonary exercise testing (CPET) is an important modality for the evaluation and management of patients with a diverse array of medical problems or symptoms. However, interpreting these tests requires significant expertise, and is often difficult and time consuming. Develop a Computer-Aided Interpretation System (CAIx) to help physicians and physiologists in objectively evaluating CPET test results.
Methods
A total of 239 CPET results from the Institute of Pulmonology, Sheba Medical Center were used, from which n=150 CPET test results were used for the Support Vector Machine (SVM) learning stage (n=50 healthy participants; n=50 patients with moderate-to-severe chronic heart failure (CHF), and n=50 patients with chronic obstructive pulmonary disease (COPD)). The remaining 89 tests from a similar population were used for the SVM's disease, type and level of exercise intolerance and module validation. The performance of the SVM was compared with the clinical diagnosis using distribution analysis.
Results
The CAIx successfully classified normal participants and CHF and COPD patients. The positive predictive values (PPV) were 94%, 92%, and 79% respectively for the normal, CHF, and COPD patients. The negative predictive values (NPV) were correspondingly 96%, 97%, and 91%. Consequently, the sensitivity, specificity and overall preciseness of the proposed module were 89%, 94%, and 89% respectively. An Exercise Limitation Classification Module (ELCx) contained within the SVM was able to accurately classify the type and level of the exercise limitations with 95% sensitivity, 97% specificity, and 95% precision.
Discussion
The new CAIx and the ELCx modules developed herein for CPET analyses are highly sensitive and specific and provide proof-of-concept for computer-aided-interpretation. Their use may reduce the complexity, increase the objectivity, and be time saving of CPET interpretation in clinical settings.

Oral presentations

OP-PM40 Training in leisure sport

SELF-REGULATED COMBINED HIGH-INTENSITY AND SPRINT INTERVAL TRAINING CONFERS VASCULOPROTECTION

KILDING, A.E., SETHI, S., LOWE, A.

AUT UNIVERSITY

Introduction

Controlled laboratory-based studies have demonstrated that aerobic, high-intensity and sprint interval training (HIT and SIT respectively) independently confer vasculoprotection, thereby reducing cardiovascular risk. However, no study has quantified effect magnitudes when exercise is self-regulated. Therefore, the aim of this study was to determine the effects of self-regulated combined HIT and SIT on arterial health.
Methods
Using a repeated-measures between-subjects design, fifteen healthy, sedentary adult males were randomly assigned to an experimental (EXP) or control (CON) group. The CON group maintained their routine lifestyle for eight weeks. The EXP group attended 3, 45 min self-paced cycle-based group sessions per week involving HIT and SIT for eight weeks. Exercise was undertaken at a local gym. A range of assessments were carried out at baseline (PRE), after four weeks (MID), and post-intervention (POST) including: peak oxygen uptake (VO2peak), resting carotid-femoral pulse wave velocity (cfPWV), augmentation index (AIx@75), central pulse pressure (cPP), wall thickness (common carotid and femoral intima-media thickness, cIMT and fIMT respectively), and arterial geometry (common carotid end-diastolic diameter, cEDD, and wall:lumen ratio, cWLR).
Results
The average heart rate during self-regulated sessions was 81±7%HRpeak. Improvements in VO2peak and arterial health measures from PRE to POST were observed in EXP only ($p<0.05$). At POST, there were significant between-group differences in VO2peak, cfPWV, cPP, fIMT, cEDD, and cWLR ($p<0.05$). In conclusion, self-paced HIT and SIT cycling improves VO2peak and reduces arteriosclerotic and systemic wall thickness indices in healthy, sedentary adults.
Discussion
In consonance with evidence from laboratory studies, the present results demonstrate the effectiveness of a community-based exercise approach to enhance arterial health.

MICROPAUSE RUNNING: A MORE PALATABLE ALTERNATIVE TO MODERATE INTENSITY CONTINUOUS RUNNING

WALSH, A., DELAHUNT, E., MATTHEWS, J., BOREHAM, C.

UNIVERSITY COLLEGE DUBLIN

Introduction
Despite the well-established health benefits accruing from regular exercise such as running, lack of time and unpalatability of vigorous effort are barriers that deter large sections of the population from taking part. This study was conducted, therefore, to compare the subjective response to moderate intensity continuous running (MIC) with running that incorporates short breaks (micropauses) of either 15 seconds (MP15) or 30 seconds (MP30).
Methods
Following institutional ethics approval, ten recreationally active male volunteers (age = 22.1 ± 1.2 years; body mass = 80.9 ± 7.3kg; height = 180.3 ± 4.6cm) were tested under controlled laboratory conditions on three occasions, at least one week apart. On day one participants performed MIC at 65% of previously determined VO2max until they expended 400kcal of energy. Participants' Rate of Perceived Exertion (RPE) was measured at regular intervals throughout the run. Immediately post exercise, blood lactate (La) levels were assessed, and participants completed the Physical Activity Enjoyment Scale (PACES) and Physical Activity Affect Scale (PAAS). On days two and three, participants completed the micropause protocols, running at 80% of their VO2max. For their respective protocols, passive rests of either 15 or 30 seconds were interspersed at 3 minute intervals throughout the run. Energy expenditure was isocaloric in each protocol and all other methodology was standardised across testing sessions. A Shapiro-Wilk test was run to test normality of distribution; with one way ANOVAs undertaken on each outcome measure, with post-hoc testing for further comparison.
Results
The PACES score was significantly higher ($P<0.05$) in MP15 (95.8 ± 7.8) than both MP30 (89 ± 6.6) and MIC (79.6 ± 7.8). Additionally, the PACES score was significantly higher in MP30 (89 ± 6.6) than MIC (79.6 ± 7.8). On the positive subscale of the PAAS, MP15 (8 ± 1.5) and MP30 (7.3 ± 2.4) resulted in significantly ($p<0.05$) higher scores than MIC (4.9 ± 1.2). There were no significant differences in the negative or the fatigue subscales of the PAAS across protocols. RPE scores were significantly ($p<0.05$) lower in MIC (12 ± 1.3) than MP30 (14 ± 1) and MP15 (15 ± 1.5). La was significantly lower ($P<0.05$) in MIC (1.8 ± 0.2mmol/L) than both MP15 (3.7 ± 0.8mmol/L) and MP30 (4.4 ± 0.8mmol/L).
Discussion
Micropauses resulted in higher levels of enjoyment, and higher positive affect scores post exercise, with the MP15 protocol being more enjoyable than MP30. Despite increased perceived effort and metabolic strain during exercise, micropauses facilitate running at a higher intensity yet with increased enjoyment, and this is perceived as no more fatiguing than MIC at a lower intensity.

TEACHING MOTIVES, GOALS, AND STRATEGIES OF EXPERIENCED YOGA TEACHERS.

VERGEER, I., O'SULLIVAN, G.

UNIVERSITY OF SOUTHERN QUEENSLAND; VICTORIA UNIVERSITY

Introduction
Yoga is an ancient Indian practice that has become increasingly popular in western societies in recent years. Embedded in a holistic philosophy of wellbeing, it goes beyond what is typically offered in traditional western exercise settings. While there is growing evidence for the physical and mental benefits of yoga (e.g., Ross & Thomas, 2010), there is limited knowledge about the delivery of yoga. Therefore, the aim of this study was to explore the motives and goals of experienced yoga teachers, and the strategies they use in delivering this ancient practice in modern western society.
Methods
In-depth interviews were conducted with experienced yoga teachers [n=7; ages 47–67 years; yoga practice experience 9–40 years (median 32); yoga teaching experience 3–25 years (median 14)], focusing on what motivated them to become a teacher and what they aimed to convey to their students. Interviews were recorded, transcribed, and subjected to a thematic analysis (Braun & Clarke, 2006).
Results
Results showed that a strong motive for teaching was the desire to pass on the holistic benefits of yoga that teachers had experienced themselves. Additional motives included: having a reason to immerse oneself even deeper into yoga, seeing the beneficial effects in one's students, providing an antidote to the stresses and structures of modern life, and taking yoga to different groups. Teachers had a range of goals within their teaching to support their desire to pass on the benefits of yoga. These included trying to "warm" people to yoga - using strategies to make sure the teaching was paced properly and yoga would be palatable for the western mind. At the same

time, they were keen to ensure their students realised that yoga is more than a physical practice, carefully gauging students' readiness for yoga's non-physical elements. They also aimed to give students both opportunities for and ways of self-inquiry, as well as "tools for living". Furthermore, they aimed to be living examples, showing that yoga tools work for dealing with life's challenges.
Discussion
In conclusion, having themselves experienced a range of holistic benefits of committed and prolonged yoga practice, yoga teachers were motivated to pass on these benefits to their students and thereby enhance students' capacity for dealing with the challenges of modern life. To this end, they had various goals and employed a range of strategies to create effective teaching environments.
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EFFECTS OF A 12-WEEK LOW FREQUENCY LOW-VELOCITY RESISTANCE TRAINING PROGRAM ON KNEE EXTENSOR STRENGTH, BODY COMPOSITION, AND CARDIOVASCULAR FITNESS IN HEALTHY SEDENTARY INDIVIDUALS; A PILOT STUDY.

GERRITS, K., DE WIT, C., WIJMER, K.
AMSTERDAM MOVEMENT SCIENCES, VRIJE UNIVERSITEIT AMSTERDAM

Introduction
Traditional forms of strength training contain 2-3 sessions of high intensity resistance exercise a week to improve muscle strength. It has been suggested that 20 min of once-a-week Super Slow Resistance Training (SSRT) might qualify as a viable alternative for improvement of muscle strength as well as cardiovascular fitness. However, evidence is scarce and equivocal to support a beneficial effect of such training regime. This pilot was designed to investigate the possible effectiveness of 12 weeks of once-a-week SSRT on improvement of leg muscle strength, cardiovascular fitness and body composition.
Methods
Sixteen participants (10 females, 38±3 yrs) were included in de training group (T) and completed a 12-week program containing a 20-min upper and lower body SSRT workout once a week. Six other subjects (3 females, 44±4 yrs) did not train and served as controls (C). Before and after the 12-week period, all subjects were tested for their knee extensor strength during isometric maximal voluntary contraction (MVC), aerobic capacity (VO2max) and maximal heart rate (HRmax) during a graded maximal cycling exercise test, and body fat%. Progression in leg press resistance (LPR), HR data during one representative training session (expressed as %HRmax), and training logs were collected throughout the intervention.
Results
The trainees completed an average of 0.94 sessions per week, with a total of 10.4 sessions. During the training period LPR increased from 93±6 kg to 114±7 kg ($p<0.01$). Average %HRmax collected in trainees (n=8) during one representative training session was 60±3%. Body fat% reduced slightly from 28±2 to 27±2% in T, $p<0.05$ but also in C from 25±2 to 23±2%, $p<0.05$, which was not significantly different between groups. After 12 weeks of SSRT, MVC remained unchanged for T (713±49 vs 706±43N) and C(779±145 vs 786±149 N), $p>0.05$. Similarly, VO2max remained unchanged in both T (36±9 vs 36±8 ml/kg/min) and C (38±7 vs 37±7 ml/kg/min), $p>0.05$.
Discussion
Although training load progressed during a 12-week period of a once-a-week 20-min SSRT, the results from this pilot study indicate that this training regime is insufficient to produce significant changes in non-specific isometric knee extensor strength, cardiovascular fitness or body composition.

MIND-MUSCLE CONNECTION: EFFECT OF VERBAL INSTRUCTIONS ON EMG DURING BENCH PRESS IN RESISTANCE TRAINED MALES.

SAONCELLA, M., PACELLI, Q.F., MARCOLIN, G., GRIGOLETTO, D., PAOLI, A.
UNIVERSITY OF PADUA

Introduction
Strength and conditioning coaches and rehabilitation professionals have an interest in which muscles are involved in various activities, to what level they are activated, and how their involvement might be emphasized or perhaps even deemphasized. Researches indicate that it may be possible to modify muscle activity during exercises without changing the exercise's execution. To determine if resistance trained males were capable of selectively activate pectoralis major or triceps brachii muscles according to specific instructions provided during the bench press exercise.
Methods
Participants included 13 experienced males (25.6±5.4 yrs, 182.7±9.1 cm, 86,4±9,7 kg, 109.1±12.8 kg one repetition maximum -1 RM). Electromyography (EMG) signal of sternocostal head (SP) and clavicular head (CP) of pectoralis major, anterior deltoid (AD), and longhead (LT) of triceps brachii was recorded during bench press exercise. Participants performed one uninstructed set (UIS) of 4 repetitions at 50% 1-RM and one uninstructed set (UIS) of 4 repetitions at 80% 1-RM. Four more sets of 4 repetitions at 50% and 80% 1-RM were randomly performed with verbal instructions to isolate the chest muscles (chest instructed set, CIS) or to isolate the triceps muscles (triceps instructed set, TIS). The EMG data was rectified and integrated and both the average and the maximum activity for each muscle during the whole range of motion was averaged over the two central repetitions for each set.
A two-way ANOVA (2x3) for multiple comparison was used to compare the differences in EMG activity for each muscle between the uninstructed, chest-instructed and triceps-instructed conditions.
Results
Participants showed a 46.26% significantly higher ST activity ($p=0.0199$) during TIS at 50% 1-RM compared to UIS and a 23.80% significantly higher ST activity ($p=0.0061$) during the TIS at 80% 1-RM compared to UIS when the average activity was considered. On the other hand we measured a 63.22% significantly higher ST activity ($p=0.0072$) during TIS at 50% 1-RM compared to UIS and a 47% significantly higher ST activity ($p=0.0250$) during TIS at 50% 1-RM than CIS when the maximum activity was considered.
Discussion

Verbal instructions seem to be effective for increasing activity of triceps brachii but not for pectoralis major during the bench press. Future studies should investigate whether or not these effects could be increased through training with verbal instructions.

Oral presentations

OP-PM65 Effects of training: Mixed session

INFLUENCE OF A NEW DEVELOPED SWIM SNORKEL – AN INTERVENTION STUDY

ZELLER, S., DRACHLER, T., MEYER, C., ABEL, T., STRUEDER, H.K.
GERMAN SPORTS UNIVERSITY COLOGNE

Introduction
Scientific literature examining the influence of a swim snorkel is lacking. The aim of the present study was to analyze possible effects on performance, ventilatory and metabolic parameters of a new developed swim snorkel during a 9-week training intervention study.
Methods
Twenty sport science students, 12 males and 6 females (22.15 ± 2.4 years, 1.78 ± 0.08 m, 70.2 ± 10.8 kg, BMI 21.9 ± 2.0) were recruited for this intervention study. The subjects completed 18 training sessions over 9 weeks while each training session included 2000-2400 m of swimming. After an initial critical swim speed-test (CSS-test) (Dekerle et al., 2002) the subjects were divided into two matched pair groups (variable: 400 m time-trial time). The intervention group used a swim snorkel (AMEO Powerbreather LAP Edition) during drills and the main-part of each training session, the control group did not use the swim snorkel at all. Before and after the intervention a CSS-test (400 and 200 m time-trial), ventilatory tests (forced expiratory vital capacity [FVCex] and Forced Expiratory Volume in 1 second [FEV1]) and two-speed test were examined (Olbrecht et al., 1985).
Results
Time-trial times of 400 m (pre: 538 ± 65 s / post: 474 ± 49 s) and 200m (pre: 196 ± 29 s / post: 182 ± 23 s) improved significantly ($p<0.001$) over time, but no differences between groups were found. CSS did not change over time or between groups. FVCex (pre: 5.49 ± 1.27 l / post: 5.41 ± 1.20 l) and FEV1 (pre: 4.67 ± 0.99 l / post: 4.60 ± 0.95 l) changed significantly ($p<0.01$) over time but not between groups. While lactate concentrations at velocity of 85% of 400m best time changed significantly ($p<0.001$) over time, peak lactate concentrations after the 400m time-trials did not. Here, no influence of groups was found.
Discussion
There is no positive influence using a new developed swim snorkel during a 9 week intervention study. Training over 9 weeks is valuable to improve swim performance in sport science students, while respiratory parameters declined. According to these results further studies should examine the most beneficial use of a swim snorkel during training to increase swim performance.
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EFFECT OF ENDURANCE TRAINING ON SKELETAL MUSCLE AND PLASMA APELIN LEVELS IN TYPE 2 DIABETIC RATS

SONG, W.
SEOUL NATIONAL UNIVERSITY

Introduction
Exercise-induced apelin as a myokine is believed to play a role in the improvement of type 2 diabetes mellitus(T2DM) and capillarization. Here, we evaluated the association of exercise-induced apelin and their capillarization.
Methods
Zucker diabetic fatty(ZDF) rats underwent treadmill exercise. The body composition, muscle strength, muscle sizes and capillarization, and insulin resistance(Homeostatic Model Assessment [HOMA-IR]) were measured. Apelin protein levels of skeletal muscle and plasma were then analyzed.
Results
Treadmill exercise improved the body composition($P<0.05$), insulin resistance($P<0.05$), and grip strength($P<0.001$). In the soleus, the decreased muscle fiber size($P<0.001$) and muscle capillarization were increased($P<0.001$) after exercise in T2DM. The increase of plasma apelin level($P<0.05$) and decrease in soleus muscle($P<0.01$) as well as an association between soleus apelin levels and angiogenesis($P<0.01$) were found.
Discussion
A role for exercise-induced apelin in improving metabolism indicates the possibility of a new drug target for the treatment of metabolic diseases and repairing skeletal muscle damage.

NEUROPHYSIOLOGICAL CORRELATES OF FLEXIBILITY GAINS THROUGH MOTOR IMAGERY

KANTHACK, T.F.D.1,2, GUILLOT, A.1,3, COLLET, C.1, PAPAXANTHIS, C.4, GUIZARD, T.1, COLLET, C.1, DI RIENZO, F.1
1: UCBL (LYON, FRANCE), 2: CAPES (BRASÍLIA, BRAZIL), 3: IUF (PARIS, FRANCE), 4: UB (DIJON, FRANCE)

Introduction
The effectiveness of motor imagery (MI) to facilitate stretching performance is controversial in the literature, and the mechanisms underlying such gains are uncertain, with hypotheses ranging from psychological to physiological effects (Vergeer and Roberts, 2006; Guillot et al., 2010). Here, we evaluated the impact of performing MI during stretching, while recording muscle activity through electromyography (EMG) of both the rectus femoris and hamstring of the dominant leg, as well as autonomic nervous system responses.
Methods
Thirty healthy participants were randomly allocated to a MI practice (n=15) or Control group (n=15). They completed 2 blocks of 5 stretching trials on the sit-and-reach task (2 min interval). During the first block (B1), participants performed 5 maximal stretching trials lasting 10s

(10s interval). The 5 Sit-and-reach trials in the second block lasted 20s (10s interval) and were divided in two parts (B2-B3) respectively requiring: i) reaching the maximum performance achieved during B1 (10s), and ii) attempting to achieve a better performance (10s). MI practice focused on hamstring stretching process and body relaxation, while completing B2 and B3.
Results
Data revealed greater performance improvement in the MI group (2.9±2 cm) than in the Control group (1.5±1.6 cm) at B3 ($p<0.05$).Both groups showed a decrease in EMG data from B1 to B2, which was sustained during B3. However, participants in the MI group activated 27±1 % less at B2 ($p<0.001$), and 28±1 % less at B3 ($p<0.001$) than the Control group. Autonomic nervous system recordings further revealed greater sympathetic activation at B3 for both groups compared to B1 (366±50 %, $p<0.001$) and B2 (394±55 %, $p<0.001$), with no Group by Block interaction ($p=0.24$).
Discussion
Performing MI during actual practice improved flexibility by reducing muscle response to stretching, hence allowing a more effective stretch of the connective tissues. We postulate that MI practice effects might originate from central adaptations, particularly a cortical gain over spinal networks mediating the stretch reflex (Grosprêtre et al., 2015). The present study may contribute to fruitful applications of MI practice in both sport sciences and rehabilitation.
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Contact
thiago.ferreira-dias-kanthack@etu.univ-lyon1.fr

EFFECTS OF 60 DAYS OF SIMULATED MICROGRAVITY AND THE INFLUENCE OF JUMP EXERCISE COUNTERMEASURE ON CARDIORESPIRATORY KINETICS

THIESCHAEFER, L., KOSCHATE, J., DRESCHER, U., HOFFMANN, U.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Muscular oxygen uptake (V'O2musc) kinetics tend to decelerate by long-term exposure to microgravity (Hoffmann et al., 2016). The effects of 6°-head-down-tilt bed rest (HDT), which is commonly used as a long-term microgravity analog, on heart rate (HR) kinetics and V'O2musc have not been reported yet. During long-duration space missions, countermeasures are applied to mitigate microgravity induced adaptations. Kramer et al. (2017) introduced a novel jump exercise countermeasure and evaluated its effects during HDT. The aim of this study was to get insights into HR and V'O2musc kinetics changes to long-term HDT and furthermore the influence of jump exercise countermeasure on these kinetics.
Methods
Twenty-two participants (29 ± 6 years, 181 ± 6 cm, 77 ± 7 kg) were randomly subjected to 60 days of HDT either with (JUMP, n = 11) or without (CTRL, n = 11) almost daily jump exercise in a sledge jump system. Nine days before HDT (BDC-9) as well as two (R+2) and thirteen (R+13) days after HDT subjects performed random work rate (WR) changes (30 W and 80 W) on a cycle ergometer with HR measured beat-to-beat and oxygen uptake breath by breath. V'O2musc was estimated by the approach of Hoffmann et al. (2013) implementing a circulatory model. Kinetics were assessed applying time series analysis by cross-correlating WR with HR or V'O2musc. Higher maxima (CCFmax) of the resulting function imply faster kinetic responses. Mixed-design ANOVA with the factors time and group was calculated to investigate differences.
Results
CCFmax(HR) was significantly different across the three time points ($p < .05$). No group effect or an interaction of time and group were found. Post-hoc tests revealed a significant difference in the CTRL group only from BDC-9 to R+2 (0.352 ± 0.028 vs. 0.269 ± 0.019; $p < .05$) but not for the JUMP group. Neither time nor group effects on CCFmax(V'O2musc) were observed.
Discussion
Contrary to observations during long-term microgravity exposition there is no evidence of deceleration of V'O2musc kinetics under these simulated conditions. The difference might be explained by the absence of gravitation in space sojourns and by longer mission durations (153 ± 25 days). HR kinetics were significantly slowed after bed rest deconditioning in the CTRL subjects only. This emphasizes the efficiency of the jump exercise countermeasure in preserving HR kinetics.
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Contact
l.thieschaefer@dshs-koeln.de

THE EFFECTS OF HANDCYCLE UPPER BODY TRAINING ON PHYSICAL CAPACITY AND WHEELCHAIR PROPULSION EFFICIENCY IN ABLE-BODIED MALES

CHAIKHOT, D., REED, K., PETROONGRAD, W., ATHANASIOU, F., VAN KOOTEN, D., HETTINGA, F.J.
UNIVERSITY OF ESSEX

Introduction
Handcycle upper body training is a promising exercise alternative for wheelchair users (Hettinga et al., 2010). Little is known about dose-response effects of training on physical capacity and wheelchair propulsion efficiency. The aims of this study were to determine the training effects of a specific dose of training on physical capacity and mechanical wheelchair propulsion efficiency.
Methods
Participants (age: 25.7 ± 4.2 years, stature: 1.75 ± 0.07 m, body mass: 72.9 ± 12.9 kg) were divided into a training group (TG; n = 10) and a control group (CG; n =10). TG received a 4-week upper body resistance training (RT) and high intensity training (HIT). During RT, 3 sets of 10 repetitions, of 8 different exercises were performed twice per week. The load was 70% of 1 repetition maximum. HIT consisted of arm-crank ergometer exercise: 7 intervals of 2 minutes at 80-90% of maximal heart rate (HRmax) with a 2- minute active rest interval of hand-

cycling exercise at 50-60% of HRmax. CG received no training. TG and CG performed a pre and post- incremental test until volitional exhaustion to evaluate physical capacity and a pre and post- 4-minute submaximal wheelchair propulsion test at comfortable speed (CS), 125% CS and 145% CS to evaluate fraction of effective force (FEF) and mechanical gross efficiency (GE). A repeated measures analysis of variance (group x time) was performed ($p < 0.05$) to evaluate differences between groups in physical capacity (POpeak & VO2peak), and efficiency (FEF and GE) measured in pre and post-tests.
Results
POpeak (29.93 ± 13.87%) and VO2peak (14.09 ± 11.39%) in TG improved significantly compared to the CG (POpeak -5.81 ± 16.23%; VO2peak-3.51 ± 8.63%), as demonstrated by significant main and interaction effects. No training effects on FEF and GE could be identified.
Discussion
Our study was the first study to examine the effects of a 4-week combined upper body RT and 7x2 HIIT program on physical capacity and wheelchair propulsion efficiency. Our findings have clearly shown the physiological gain in the training group. However, this did not translate into improved efficiency. This might be because handcycling exercise does not reproduce the pushing movements required for propelling a wheelchair. Results indicate that though handcycle training results in improved physical capacity, additional wheelchair skill training might be needed to fully benefit from this advantage in daily life propulsion.
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Contact
dchaik@essex.ac.uk

MONITORING OF FUNCTIONAL AND PSYCHOPHYSIOLOGICAL STATE OF ATHLETES DURING TRAINING CAMP

KLYUCHNIKOV, M., RAZUMETS, I.

FEDERAL RESEARCH AND CLINICAL CENTER OF SPORTS MEDICINE AND REHABILITATION FMBA RUSSIA

Introduction
One of the main problems occurring during training camps is objective assessment of functional and psycho-physiological state of athletes. There are a number of methods, including biofeedback which allows the assessment of psychological and physiological state of athletes based on heart rate variability (HRV). However, to date there are no specific criteria and algorithms to interpret the data obtained from the analysis of athletes' HRV. The article describes an algorithm of express monitoring of dynamic changes in functional and psychophysiological state of elite athletes during training camp.
Methods
The study involved 26 basketball players (female, aged 17-22 years, mean age – 18.2±2.03 years). To evaluate athletes' functional and psychophysiological state we used the analysis of heart rate variability (HRV) with ES Teck System Complex (LD Technology) and with further assessment of autonomic nervous system state. The HRV analysis had been done in three referent points: at the beginning (Control), in the middle and at the end of training camp before and after training process. Four major parameters were included in algorithm of evaluation of functional and psychophysiological state: stress response, cardiac sympatho-vagal balance (LF/HF), heart rate (HR), the probability of psychological breakdown. The statistical analysis was made by Statistica 10. To compare the groups we have used Student's t-Test and one way ANOVA multiple comparison test. Values of $p<0.05$ were considered as significant.
Results
The stress response to training was maximal in point 2 of study and minimal in point 3 compared to point 1 (Control). This indicates the body's adaptation to physical load at the end of camp. The changes in HR correspondent to stress response. The average HR change was more expressed after the training in point 2. In point 3 of training camp the HR is more stable. The LF/HF parameter was more or less stable during whole training camp. There was moderate prevalence of parasympathetic (autonomic) regulation in point 1, which characterizes optimal state of regulatory systems. Point 2 – slight prevalence of sympathetic system (moderate tension in regulatory systems), point 3 – almost no changes. Thus here we also have the adaptation to physical load.
Discussion
1) The changes in functional and psychophysiological state of basketball players varies depending on the stage of athletic preparation; 2) The precompetitive training camps improves psychophysiological stability and reduce the lability of the nervous system; 3) Dynamic monitoring of HRV during camps allows to adjust individual training process and program of biomedical support for the athletes.

Oral presentations

OP-SH07 Experiences in Sport

AN EXPLORATIVE STUDY OF EXPERIENCE OF RECREATIONAL TEAM SPORT ATHLETES: A QUALITATIVE RESEARCH

IGBOKWE, E.

FRIEDRICH ALEXANDER UNIVERSITY

Introduction
Team sports are popular all over the world and have been seen by many societies as an acceptable and favoured form of participation in sport. It is thought that participation in team sports is generally beneficial, and young people are encouraged to participate in team sports. However, little is known about the first-hand experience of the team sports athletes. We sort to hear from the proverbial horse's mouth. Using the symbolic interactionism theory, we explored how athletes create meaning out of team processes. Qualitative interview was conducted to gain in-depth knowledge of the experiences of recreational team sport athletes.
Methods
11 individuals, 9 males and 2 females were interviewed separately. The interviews lasted between 30 minutes to 50 minutes. 9 of the participants are no longer involved in the sport as at the time of the interview. The interviewers received training on qualitative interviewing and had 30 minutes of two sessions of mock interview. Data analysis was done using the cut and paste method.
Results

From the data collected the most prevailing themes were; acquisition of life skills; more specifically, improved social skills resulting from improved communication skills. Others are; feeling of enjoyment and fun, and portrayal of negative experiences as positive.
Discussion
The participants transferred the life skills acquired in team sports to real life situations. This finding is in contrast to the result by Holt et al. (2008), where the study found no transfer of life skills in high school soccer players from the sport sphere into real world.
The overall portrayal of negative experiences in positive light might be due to societal bias to team sport, therefore the participants do not want to go against the social norm. Fun and enjoyment was frequently identified as reason for continuous participation in team sports.
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Contact:
emmanuel.igbokwe@fau.de

CHILDREN'S PERSPECTIVE OF GAME: A COMPARISON OF STATE SCHOOLS AND COLLEGE

GUNDUZ, N., TAŞPINAR, T., MEMIŞ, N.
ANKARA UNIVERSITY, SPORT SCIENCE FACULTY

The purpose of this study is children's perspective of game: a comparison of state schools and college. The research is a mixed design research where qualitative and quantitative data are used altogether and the opinions of children and parents are also received.
The universe of the study covers all third grade student' parents in two state primary school and two college for the quantitative part (n =450). The study sample consists of 250 students who are returned to the distributed questionnaires. The sample for the qualitative data of the study includes 32 students, volunteerly participant from these four schools, 4 girls and 4 boys from each school playing freely outside the home. In collection of quantitative data in the research, providing information to parents and a mini-survey study including 4 questions has been used in the research. With this survey study, it has been asked whether children played games or not, what they played with and where they played. Qualitative data of the research is composed of half-structured interview questions prepared separately for student (13 question) voluntarily attending to the research and identified according to the views of this questionnaire. Interview questions, have been formed by considering the studies conducted in this field and taking experts' opinions. Quantitative data have been obtained by half-structured interview method, and interviews have been made in a closed room after informing parents and students and making appointments beforehand. Voice recorder is used during interviews.
Descriptive statistics were used in the quantitative data and the results were interpreted in tables with frequency percentages and averages. In the qualitative study, content analysis method was used for the evaluation of the interview. According to the quantitative results, all parents emphasized that their children both played at home or in the garden and played with toys, tablets, and etc. at home while played with balls, skip ropes, and etc. in the garden. Their play mates are friends, siblings, or their cousins. According to qualitative results, children stated that games meant "entertainment" for them. They played "at school and in the garden of their house", and they played with their friends. The students are encouraged to play outside, while the students play in the private school, they are more comfortable than others because the students live in the site. However, they stated that they live in traffic and security problems

THE INVESTIGATION OF BODILY KINESTHETIC INTELLIGENCE LEVELS OF ADOLESCENTS WHO TAKE PART IN SPORT SCHOOLS

OZTURK, A., AKSOY, M., OZGUR, O.B., OZGUR, T., YILMAZ, O.
HEALTH SCIENCE

Introduction
Gardner defines intelligence as the capasity to create a product that is valued in one or more cultural setting and as the skill to generate efficient and effective solutions to the problems encountered in life and as the ability to discover the problems with complicated nature or that are required to be resolved (Gardner, 2004). The aim of this study is to investigate the effects of 8 week long basic tennis drills and table tennis drills.
Methods
This study is to performed two times a week on bodily/kinesthetic intelligence of adolescents aged between 12-14. The sample of the study consisted of 156 adolescents (75 girls and 85 boys) attending sports schools in Kocaeli. In the study, bodily/kinesthetic intelligence scale, a subscale of Multiple Intelligence Theory, developped by Gardner in 1983 and adapted to Turkish by Saban in 2002 was used as well as the 8 week basic drills.
Results
Bodily Kinesthetic Intelligence (BKI) levels were not different between tennis and table tennis groups. Statistical analysis was conducted based on gender, age groups (12, 13, 14 years) and exercise type. Independent samples t test revealed that there was no significant difference between the BKI levels of males and females. One way anova test revealed that there was significant difference between the BKI levels age groups (12, 13, 14) in the post test. However, Paired samples t test revealed no significant differences between pre-post test results of adolescent's BKI levels. In conclusion, despite the relatively long term (8 weeks) physical activitiy, the BKI levels did not show significant differences.
Discussion
This study, some important findings were gathered on the bodily/kinesthetic intelligence levels of adolescents in the developmental period. In this regard, it is suggested that longer term drills should be planned and bodily kinesthetic intelligences should be investigated accordingly in the future studies. Besides, more studies are needed in order to determine and enhance the dominant intelligence levels in adolescents in developmental period.
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Contact
ardaozturk82@hotmail.com

EDUCATION-BASED SPORT-FOR-DEVELOPMENT: EXPERIENCES FROM PAPUA NEW GUINEA

FRAWLEY, S., SCHULENKORF, N., SHERRY, E., SEAL, E.

UNIVERSITY OF TECHNOLOGY SYDNEY

Introduction
League Bilong Laif (LBL) is a sport-for-development (SFD) program that was established in 2013 as a three-way partnership between the Australian Government, the Papa New Guinea (PNG) Government's Department of Education, and the Australian Rugby League Commission. Against a challenging background of low school attendance rates across PNG, significant problems with anti-social behaviour, and ongoing issues with gender equity, the sport-based program was designed to contribute to PNG students' educational and social engagement, with a particular emphasis on gender equity and respect. Additionally, there was a focus on improving the capacity of local PNG staff and school teachers to conduct rugby league-based development activities. In our presentation, we look back at the pilot phase of the LBL project and critically discuss the achievements and complexities of an SFD program that has been delivered in a truly complex socio-cultural environment.
Methods
To gain a deeper understanding of the LBL initiative, emphasis in our qualitative research has been placed on the perspectives of those individuals involved 'on the ground'; in short, 'local experiences' have been gathered via interviews and focus groups with LBL participants, organizers and stakeholders. Following an interpretive mode of enquiry, our data analysis was guided by a systematic coding process recommended by Miles, Huberman and Saldana (2014). This involved a broad read through the raw data, a search for recurring concepts and patterns, and a grouping together of major concepts into broader themes.
Results
Our preliminary findings have been loosely categorised according to Coalter's (2008) logic model for SFD programs in respect of 'outputs', 'outcomes' and 'impacts'. Findings indicate that the LBL program's key outputs include the development and training of LBL staff and the increased capacity of teachers to deliver education-based aims in conjunction with sport programs. Next, there have been improved opportunities for local children to participate in sport and to access educational materials. In addition, there has been greater inclusion of girls in sporting contexts with the program tailored towards securing their participation.
Discussion
While it is not possible to assess the longer-term social/educational impacts and outcomes on children during these initial stages of our research, initial themes emerging from the data may be categorized as increased levels of self-esteem, greater respect (to self and others) shown, improved discipline and school attendance. Finally, our findings also suggest that it is imperative to develop and strengthen relationships with key stakeholders to secure the sustainability of the SFD program and to transfer and truly embed the initiative in local institutions and communities.
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SPORTS CLUBS APPROACH TO MAINSTREAMING OF DISABILITY SPORT: A CRITICAL ANALYSIS

CHRISTIAENS, M.

COVENTRY UNIVERSITY

Introduction
Over the years' disability sport has been an under-researched area in both sport and disability studies (Huang, 2005), this is only being addressed in the last couple of years. Most research approaches the topic from a sports science perspective or focuses on the elite level. Only a limited amount of studies have a focus on the grassroots level of sports delivery. Even fewer have a focus on mainstreaming of disability (sport) policy (Harris & Houlihan, 2014; Thomas & Guett, 2014). This should come as a surprise when knowing that within the UK alone there are around 10 million people with disabilities, of which only 17% are active in sport (Sport England, 2016). When compared to able-bodied, of whom 36.1% is active in sport (Sport England, 2016), a big disparity becomes apparent. This disparity is bigger than any other well-known under-performing group (EFDS, 2016). As such, this study is an attempt to bridge this knowledge gap by focusing on grassroots sports clubs and how they approach mainstreaming. Mainstreaming is the idea that people with disabilities should have equal opportunities to participate in sport and that 'conventional' sport activities or sport clubs should be integrating people with disabilities.
Methods
This research was approached in two ways. First of all, there is a lack of information on sport participation at the club level for people with disabilities. As such a survey was adopted that questioned athletics and swimming clubs about their disability membership. The second part of the study adopts interviews as the main means of data collection. This is used to explore strategies sport clubs adopt in regards to mainstreaming and get a better understanding in how sport clubs approach the topic.
Results
Mainstreaming at the club level does not seem to have caught on yet. The survey conducted for this study shows that only around 1.5% of club members is someone with a disability. This does not in any way reflect our society.
Discussion
As such it is important to explore in more depth what sport clubs are doing in regards to mainstreaming. From interviews it did become apparent that sport clubs are becoming more open towards people with disabilities, although only on a reactive base. The challenge here would be to motivate sport clubs to be adopt a more pro-active attitude towards people with disabilities. This study addresses some concerns and in turn some strategies that could help support sport clubs in adopting this pro-active attitude.
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DESIGN AND CODIFICATION STRATEGIC PLAN OF IRAN SPORTS FEDERATION FOR THE BLIND

HABIBIRAD, A.1, HONARI, H.1, KHABIRI, M.2, HAJIANZAHAEI, Z.3
1: ATU (TEHRAN, IRAN), 2: UT (TEHRAN, IRAN), 3: IAUCTB (TEHRAN, IRAN)

Introduction
Physical activity is commonly recommended to those with physical disability that includes psychological and physical gains (1). Sport and recreation is not just a hobby for someone with a visual impairment but provides an opportunity to have a better life and the individual who has this disability should be exposed to a variety of skills in interactive occupations that can prevent large amounts of time that is spent in unwanted isolation (2,3). In every country, sports federation for the blinds is the only organization that protects the sports physical activities of blinds (4). So it seems necessary to investigate this program and to detect strengths and weaknesses and the opportunities and threats.
Methods
The method of this research is a descriptive one that is known as strategic studies. The population of this research included the past and current board members of federation and caches, referees and athletes delegates, were 48. To analyze data, descriptive indicators and the strategic matrix were used and for prioritization the strategies QSPM matrix was used.
Results
The results showed that strategic situation of federation was conservative one. Results from the evaluation of internal factors show that its strengths are exceeded by its weaknesses and in terms of assessing external factors, the threats are exceeded by opportunities. 3 SO, 3WO, 2 ST and 2 WT strategies were recognized and prioritized.
Discussion
Using the strategies of this study can be very efficient in operation of federation. So it is recommended that this federation tries to attract financial resources, improve the level of sports facilities, hold training courses and investigate the performance of coaches.
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09:45 - 11:15

Invited symposia

IS-EX02 JSPFSM-ECSS EXCHANGE SYMPOSIUM: CHALLENGING PHYSICAL INACTIVITY IN CHILDHOOD AND ADOLESCENCE - WHAT CROSS-BORDER EVIDENCE AND ISSUES DO WE HAVE?

COMPARISON OF PHYSICAL ACTIVITY AND FITNESS OF ADOLESCENTS IN MAJOR ASIAN CITIES: THE ASIA-FIT STUDY

SUZUKI, K.
JUNTENDO UNIVERSITY

Introduction
In 2012, The Asia-Fit Study was lunched in order to compare levels of physical fitness, physical activity and obesity of adolescents among major metropolitan cities in East and Southeast Asia. Focusing on Japanese data, we compared the level of physical activity, physical fitness, and obesity of adolescents among major metropolitan cities in East and Southeast Asia.
Methods
A total of 12590 valid adolescents' data (age 12-15 years) were collected from eight major metropolitan cities in East and Southeast Asia, including Hong Kong, Shanghai, Tokyo, Seoul, Kuala Lumpur, Taipei, Singapore and Bangkok. Analytic items included body mass index (BMI), self-reported MVPA (IPAQ), and whether or not students engaged in sports club activity at school. Physical fitness tests included Sit-and-reach Test (flexibility), Hand Grip test (strength), 1 Minute Sit-up Test (muscle endurance) and 15 meters Progressive Aerobic Capacity Endurance Run (PACER) Test (cardiovascular endurance).
Results
Prevalence of sports club participants with 2 hours or more of physical activity each week in Tokyo (Male: 49.7%, female: 36.7%) was considerably higher than the other cities (Male: 15.7%, female: 10.5%). MVPA, Cardiovascular endurance, and muscle endurance in Tokyo were higher than the other cities. Japanese adolescents also indicated larger standard deviations than the other cities in cardiovascular endurance and MVPA. There were no significant differences in strength and flexibility.
Discussion
These findings suggested that Japanese adolescents were the most physically fit and active, whereas individual variability in the level of physical fitness and activity were much bigger than the other countries' adolescents.
This work was carried out with the aid of a research grant from the NUS Initiative to Improve Health in Asia (NIHA).
Contact
ko-suzuki@juntendo.ac.jp

THE RELATION OF CHILDHOOD FITNESS TO EXECUTIVE FUNCTION AND MEMORY

KAMIJO, K.
WASEDA UNIVERSITY

Introduction
The worldwide epidemic of childhood inactivity has become a significant public health concern. A growing body of evidence has indicated that greater participation in physical activity (PA) and higher levels of aerobic fitness are associated with superior academic achievement in children (Donnelly et al., 2016), emphasizing the importance of PA for cognitive development. Our studies focusing on executive function (i.e., higher-order cognitive abilities involved in goal-directed behaviors) and memory, which are closely associated with academic achievement, support the association between childhood fitness and academic achievement.
Methods
Our earlier studies employed a cross-sectional design and compared cognitive task performance between aerobically lower-fit and higher-fit children. However, cross-sectional findings merely demonstrate associations between PA/fitness and cognitive functions, but not their causality. To overcome this limitation, we further examined the effects of a 9-month randomized control PA intervention on executive function in preadolescent children by employing neuroelectric measures of cognition (i.e., event-related brain potentials: ERPs) and behavioral task performance, to provide a deeper understanding of the relationship between fitness and cognitive functioning.
Results
Cross-sectional studies have indicated that greater childhood aerobic fitness was associated with the greater allocation of attentional resources to task-relevant information and more efficient inhibition of task-irrelevant information (Kamijo et al., 2015). Furthermore, randomized controlled trials (RCTs) demonstrated that a 9-month PA program improved aerobic fitness and cognitive performance during executive function tasks (Hillman et al., 2014; Kamijo et al., 2011).
Discussion
Findings of cross-sectional studies by the authors suggest that greater aerobic fitness is associated with superior cognitive functioning during childhood. The RCTs support and extend these findings by showing that regular PA, which leads to increases in aerobic fitness, results in improved executive function in preadolescent children. These findings highlight the importance of PA during childhood, not only for the prevention of metabolic syndrome but also for cognitive health and development.
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Contact
k-kamijo@aoni.waseda.jp

EFFECT OF SCHOOL BASED PHYSICAL ACTIVITY INTERVENTIONS

ANDERSEN, L.
WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCES

Around 10% of children experience clustering of cardiovascular (CVD) risk factors. Low fitness and sedentary lifestyle are associated with clustered CVD risk. School based physical activity (PA) interventions may potentially be an important tool to improve health in children. Physical activity can be included in physical education lessons, during recess or related to transport to and from school. Almost all children attend school and it is therefore possible to include the least physically active children in the activities. However, some interventions have been more successful than other. We have conducted a number of different interventions using different dose and intensity of physical activity in different settings. Physical activity as part of academic lessons, during physical education lessons and as transport to school. We aim to present parameters of importance to achieve effects on physical activity level, fitness and cardiovascular risk factors: 1) what quantity, type and intensity are needed to improve health 2) how can physical activity be implemented in schools, and 3) how can we target children who need it most. Data from five school based interventions will be presented, where three are quasi-experimental designs and two are cluster randomized trials.

Invited symposia

IS-SP01 Nutrition for Muscle and Tendon Adaptation - sponsored by GSSI

THE ROLE OF ANTIOXIDANTS IN EXERCISE RECOVERY AND ADAPTATION

STEVENSON, E.
NEWCASTLE UNIVERSITY

High levels of reactive oxygen species (ROS) produced in skeletal muscle during strenuous exercise has been associated with muscle damage and reduced muscle function. Supporting the bodies endogenous defence systems with oral antioxidants to facilitate the recovery process is a research area that has received much attention. However, there is some concern that antioxidant supplementation may actually blunt adaptation to both endurance and eccentric based exercise. Studies in this area have mainly focused on supplementation with Vitamin C and E however large variations in study design, including supplement dose and duration, exercise type and biomarkers measured have meant that contradictory evidence is presented in the literature. Recently, there has been particular interest in the role of phytonutrient supplementation during exercise recovery. Phytonutrients not only have ant-inflammatory and anti-oxidant properties but also act as stimulators of signalling pathways. Emerging literature has suggested that phytonutrients provided in foods and supplements such as tart cherries and beetroot may improve exercise recovery, particularly following muscle-damaging exercise.
This presentation will evaluate the evidence surrounding the effects of Vitamin C and E and specifically phytonutrient supplementation on exercise recovery and adaptation. Acute phytonutrient supplementation studies show promising results during recovery from strenuous

exercise but the longer-term effects are still largely unknown. Chronic supplementation may hamper adaptation or conversely, benefit adaptation but this is likely dependent on a number of factors including dose and baseline nutritional status of the individual.

NUTRITION AND EXERCISE TO MINIMIZE MUSCULOSKELETAL INJURY AND ACCELERATE RETURN TO PLAY

BAAR, K.

UCDAVIS SCHOOL OF MEDICINE

Musculoskeletal injuries account for more than 70% of time away from sports. One of the reasons for the high number of injuries and long return to play is that we have only a very basic understanding of how our training and nutrition alters tendon and ligament (sinew) structure and function. Using engineered ligaments as a guide to understanding sinew physiology and function, we have learned that sinews, like bone, quickly become refractory to an exercise stimulus, suggesting that short (<10 min) periods of activity with relatively long (6h) periods of rest are best to train these tissues. Further, the addition of nutritional interventions, such as gelatin, can augment collagen synthesis as well. We have combined these interventions to develop a novel return to play protocol for elite athletes. Following an anterior cruciate ligament (ACL) rupture and surgical repair with a hamstring graft, players added the gelatin and intermittent exercise program to their traditional rehabilitation in an effort to accelerate repair of both the ligament and tendon graft site. During recovery, players saw minimal changes in body composition in the early rehabilitation period (Player 1 -0.8 kg; Σ7SF 2.7mm, Player 2 -0.4kg; Σ7SF 7.9mm). Leg lean mass reduced in both legs of player 1 (5%), with player 2 seeing an additional loss in the injured leg of 600g. Mass differences between legs returned to baseline in both players within 24 weeks. Maximal hamstring strength returned to baseline ahead of mass, at 24 and 15 weeks, respectively. This case study provides evidence that nutrition and rehabilitation programs targeted at improving connective tissue may accelerate return to play after ACL injury in a timely fashion without compromises in strength or health.

Oral presentations

OP-PM12 Eccentric Excercise

WHAT CAUSES A DECREASE IN RUNNING ECONOMY AFTER DOWNHILL RUNNING?

LIMA, L.C.R.1, NOSAKA, K.2, PINTO, R.S.3, GRECO, C.C.1, DENADAI, B.S.1

1: SÃO PAULO STATE UNIVERSITY (RIO CLARO, BRAZIL), 2: EDITH COWAN UNIVERSITY (JOONDALUP, AUSTRALIA), 3: FEDERAL UNIVERSITY OF RIO GRANDE DO SUL (PORTO ALEGRE, BRAZIL)

Introduction
Exercise-induced muscle damage (EIMD) accompanies with delayed onset muscle soreness (DOMS) and prolonged decreases in muscle function. EIMD also decreases running economy (RE), and it has been speculated that EIMD-induced strength loss is responsible for the decreased RE (1,2). However, no previous study has tested this hypothesis. This study investigated whether the decrease in RE following downhill running (DHR) is explained by the decrease in muscle function.
Methods
Forty five untrained young men (19-30 years) ran downhill (-15%) for 30 min at 70% of their maximal oxygen uptake (VO2max) speed. EIMD markers consisted of maximal voluntary isometric contraction (MVC) peak torque of the knee extensors, rate of torque development (RTD), countermovement jump height (CMJ), muscle soreness (SOR) of the knee extensors and serum creatine kinase (CK) activity. Markers of RE consisted of oxygen consumption (VO2) and stride frequency (SF) during 5-min level running at the velocity of pre-exercise 80%VO2max. These were measured before, immediately after and 1-3 days after DHR. Changes in these variables over time were analyzed by one-way ANOVA followed by Bonferroni's post hoc test. Pearson's correlation tests were used for correlations between relative changes in RE parameters and EIMD markers after DHR.
Results
EIMD markers showed significant changes after DHR ($p < 0.05$). MVC peak torque decreased immediately (-22 ± 6%), 1 (-22 ± 7%), 2 (-16 ± 6%) and 3 days (-14 ± 6%) after DHR. DOMS developed after DHR, peaked at 2 days post-DHR (58 ± 19 mm) and still existed at 3 days post-DHR (31 ± 13 mm). Serum CK activity increased after DHR and peaked 2 days after DHR (316 ± 122 U/L). CMJ decreased immediately (-13 ± 10%) to 2 days post-DHR (-16 ± 13%). RE decreased immediately after DHR indicated by increased VO2 (18 ± 5%) and this sustained until 2 days post-DHR (12 ± 4%). SF decreased immediately after (-1.7 ± 2.5%) to 2 days after DHR (-0.6 ± 1.4%). The magnitude of increases in VO2 did not significantly correlate with changes in any EIMD makers (MVC: r = -0.14; RTD: r = -0.27; CMJ: r = -0.08, SOR: r = -0.04) nor changes in SF (r = 0.20). Changes in MVC did not correlate with changes in SF (r = -0.16).
Discussion
The magnitude and the time course of changes in EIMD markers were similar to those reported in previous studies (1,2); however, the magnitude of changes in VO2 was greater in this study. The absence of correlation between changes in RE parameters and changes in MVC, RTD and CMJ suggests that decreased muscle function is not a key factor affecting RE after DHR. It might be that other factors such as impaired microcirculation and increased resting metabolic rate sustaining for some days post-DHR play a role in the decreased RE after DHR.
References
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Contact
leonardocrlima@gmail.com

COMPARISON AMONG NINE DIFFERENT ECCENTRIC EXERCISES FOR DELAYED ONSET MUSCLE SORENESS AND LOSS OF MUSCLE STRENGTH

NOSAKA, K.1, CHEN, T.C.2, YANG, T.J.2, CHOU, Y.G.2, HUANG, M.Y.2

1: EDITH COWAN UNIVERSITY (AUSTRALIA), 2: NATIONAL TAIWAN NORMAL UNIVERSITY (TAIWAN)

Introduction

The magnitude of muscle damage is greater for arm than leg muscles that performed maximal eccentric contractions on an isokinetic dynamometer (1). This might not be the case for other types of eccentric exercise. No previous study has systematically investigated delayed onset muscle soreness (DOMS) and maximal voluntary contraction strength (MVC) changes after different eccentric exercises targeting different muscles using resistance exercise machines in a gym. It is possible that muscle damage profile is different among eccentric exercises. This is important to design a study to investigate effects of prophylactic or therapeutic interventions on symptoms of muscle damage. The present study compared nine different resistance exercises often performed in a gym for DOMS and MVC changes of corresponding muscles.
Methods
Fifteen sedentary men (20-25 y) performed 5 sets of 10 eccentric contractions at 80% of MVC (no load for concentric contractions) for each on nine different resistance training machines; arm curl (AC), arm extension (AE), chest press (CP), back extension (BE), lat pulldown (LP), abdominal crunch (ABC), leg extension (LE), prone leg curl (PLC) and standing calf raise (SCR), in a counterbalanced order among the participants in the same day. DOMS and MVC strength of corresponding muscles and plasma creatine kinase (CK) activity were measured before, immediately after, and 1-5 days after the exercises. Changes in DOMS and MVC were compared between right and left sides, and among the nine exercises using a mixed-design two-way ANOVA.
Results
No significant differences in DOMS and MVC were evident between right and left sides of the body for all exercises. All exercises induced DOMS [peak: 43 ± 24 mm (ABC) to 70 ± 23 mm (BE)] and decreases in MVC for 4-5 days post-exercise [e.g. 1 day post: -16 ± 9% (LE) to -57 ± 20% (CP)]. Plasma CK activity showed large increases (peak: 16,143-207,304 IU/L), and elevated at 5 days post-exercise (14,850-187,977 IU/L). DOMS was greater ($P<0.05$) for AC, AE and BE than others, and the magnitude of decrease in MVC was greater for AC, AE and CP than others. A Spearman rank-order correlation showed no significant correlations between peak DOMS and the magnitude of MVC loss among nine exercises.
Discussion
Performing the nine eccentric exercises resulted in large increases in plasma CK activity, thus caution is required for whole body eccentric exercises. It is important to note that no significant differences between the right and left sides were found for DOMS and MVC for all exercises. The profiles of DOMS and MVC changes were different among the nine exercises such that the exercises that induced severe DOMS (e.g. BE) did not necessarily induce large decreases in MVC. Thus the choice of exercise for an intervention study is dependent on the focus of the intervention (e.g. DOMS vs muscle function).
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Contact
k.nosaka@ecu.edu.au

REPEATING NON-DAMGING LOW-INTENSITY ECCENTRIC EXERCISE LARGELY ATTENUATES MUSCLE DAMAGE INDUCED BY MAXIMAL ECCENTRIC EXERCISE OF THE ELBOW FLEXORS

CHEN, T.C.1, NOSAKA, K.2, TSENG, W.C.3, HUANG, G.L.1, HO, C.C.1, CHEN, H.L.4

1: NATIONAL TAIWAN NORMAL UNIVERSITY (TAIWAN), 2: EDITH COWAN UNIVERSITY (AUSTRALIA), 3: SANMING UNIVERSITY (CHINA), 4: NATIONAL CHIAYI UNIVERSITY (TAIWAN)

Introduction
Unaccustomed maximal eccentric contractions (MaxEC) result in severe muscle damage. It has been shown that eccentric contractions with 10% of maximal voluntary isometric contraction (MVC-ISO) strength load (10%EC) of the elbow flexors (EF) that do not result in any changes in muscle damage markers can significantly attenuate muscle damage induced by subsequent MaxEC (1). Chen et al. (2) reported that performing 40%EC every 2 weeks for 8 weeks attenuated muscle damage induced by subsequent MaxEC in the same magnitude as that observed in the second bout of MaxEC performed 2 weeks later. It is important to note that 40%EC induced some indications of muscle damage. It is interesting to investigate if repeating 10%EC would provide greater protective effect than that produced by a single bout. Thus, this study tested the hypothesis that greater protective effect against MaxEC would be observed by performing 10%EC twice a week for 4 or 8 weeks than a single bout, and the greater the repetitions, the greater the protective effect.
Methods
Sedentary young (20 - 25 years) men were randomly placed (n=13/group) to one of two training groups based on the length of training; 4 weeks (4w) and 8 weeks (8w), or a control (CON) group. The CON group performed two bouts of 5 sets of 6 MaxEC of the EF with the non-dominant arm separated by 2 weeks. The 4w and 8w groups performed 10%EC twice a week for 4 and 8 weeks, respectively, using the non-dominant EF, followed by MaxEC of the same EF at 7 days after the last 10%EC. Changes in indirect muscle damage markers before to 5 days after MaxEC were compared among the groups by a mixed-design two-way ANOVA.
Results
No significant changes in MVC-ISO, range of motion, upper arm circumference (CIR), muscle soreness (SOR), plasma creatine kinase activity (CK) and myoglobin concentration (Mb) were observed after 10%EC. After repeating 10%EC, significant increases in MVC-ISO and CIR were evident for the 4w (15.5 ± 9.6%, 1.7 ± 0.9%) and 8w groups (27.7 ± 8.9%, 3.6 ± 1.8%), with greater ($P<0.05$) increases for 8w than 4w group. Changes in all muscle damage markers after MaxEC were similar between 8wk group and the second MaxEC of the CON group. The 4w group showed greater ($P<0.05$) changes in all variables except for SOR, CK and Mb after MaxEC when compared with the 8w group, but the changes were smaller ($P<0.05$) when compared with the first bout of MaxEC of the CON group.
Discussion
The results supported the hypothesis, showing that the larger the repeated bouts of 10%EC, the greater the protective effect conferred. It is also interesting to note that repeating 10%EC improved muscle function, and the magnitude of the increase was approximately double for 8w than 4w group. It appears that the effects of 10%EC accumulate to produce muscle function improvement and muscle damage protection.
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Contact
tcchen@ntnu.edu.tw

PROTECTIVE EFFECT OF LOW-INTENSITY ECCENTRIC CONTRACTIONS ON MUSCLE DAMAGE INDUCED BY INTENSIVE WHOLE BODY ECCENTRIC EXERCISES

HUANG, M.Y.1, NOSAKA, K.2, CHOU, Y.G.1, CHEN, T.C.1

NATION1: NATIONAL TAIWAN NORMAL UNIVERSITY (TAIWAN), 2: EDITH COWAN UNIVERSITY (AUSTRALIA)

Introduction

Low-intensity eccentric contractions of the elbow flexors using a light dumbbell (10% of maximal voluntary isometric contraction strength: MVC) do not change any muscle damage markers, but provide some protection against muscle damage in a subsequent higher intensity eccentric exercise bout performed 2-14 days later (1). However, practical application of this finding has not been examined. The present study investigated the effect of 10% MVC eccentric contractions (10%EC) on muscle damage after a whole body exercise session consisting of nine different high-intensity eccentric exercises performed 2 days later to test the hypothesis that 10%EC would confer protective effect on all muscles involved in the exercises.

Methods

Sedentary young (20-25 y) men were placed to an experimental (EXP) or a control (CON) group (n=12/group). EXP group performed 5 sets of 10 low-intensity eccentric contractions (10%EC) for each of nine resistance exercises performed on resistance training machines; arm curl (AC), arm extension (AE), chest press (CP), back extension (BE), lat pulldown (LP), abdominal crunch (ABC), leg extension (LE), prone leg curl (PLC) and standing calf raise (SCR), in a counterbalanced order among the participants in the same day. Two days later, EXP group performed 5 sets of 10 eccentric contractions for each exercise with a heavier load of 80% MVC (80%EC). CON group performed 80%EC without 10%EC. Changes in MVC strength and muscle soreness of each muscle, and plasma creatine kinase (CK) activity before, immediately after, and 1-5 days after 80%EC were compared between groups by a mixed factor ANOVA.

Results

10%EC did not change any of the dependent variables. All variables changed after 80%EC for both groups, but the changes were smaller and the recovery was faster for EXP than CON group ($P<0.05$). CON group showed that MVC decreased 15 ± 9% (LE) – 59 ± 21% (CP) at 1 day post-80%EC and did not return to baseline by 5 days post-80%EC except for LE and SC, medium – severe DOMS developed [(47 ± 31 mm (LP) – 72 ± 24 mm (AE)] and resulted in high CK activity (peak: 107953 ± 64803 IU/L). In contrast, EXP group showed smaller decreases in MVC [17 ± 15% (BE) – 32 ± 20% (CP), lower peak SOR [peak: 4 ± 8 mm (ABC) – 27 ± 20 mm (AE)] and lower CK activity (peak: 3413 ± 3891 IU/L) after 80%EC.

Discussion

The magnitude of the protective effects of 10%EC on 80%EC was dependent on variables and muscles, but all exercises showed smaller changes with 10%EC prior to 80%EC such that peak CK activity was reduced by 97%, the decrease in MVC at 2 day post-80%EC was attenuated by 46% (LE) – 82% (BE), and the peak soreness was reduced by 57% (LE) – 91% (ABC). These results supported the hypothesis and showed that 10%EC was effective for attenuating the magnitude of muscle damage after 80%EC performed 2 days later for all muscles involved in eccentric exercises.

Reference

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Contact

ts03717001@yahoo.com.tw

THE EFFECTS OF ISCHEMIC PRECONDITIONING ON MAXIMAL ECCENTRIC EXERCISE-INDUCED MUSCLE DAMAGE

FRANZ, A., ZILKENS, C., MAYER, C., BEHRINGER, M., HARMSEN, J.F., SCHUMANN, M.

UNIVERSITY HOSPITAL DUESSELDORF, GERMAN SPORT UNIVERSITY COLOGNE

Introduction

Ischemic preconditioning (IPC) is known as the intermittent application of short time ischemia with subsequent reperfusion to an extremity (e.g. by using a tourniquet) and was discovered in clinical settings in an attempt to minimize inflammatory responses induced by ischemia and ischemia-reperfusion-injury (I/R-Injury) during surgery. Due to similarities between the mechanisms underpinning I/R-injury and eccentric exercise-induced muscle damage, the purpose of the present study was to investigate whether IPC performed prior to a maximal bout of eccentric contractions in the elbow flexors may protect against EIMD in previously untrained men.

Methods

Nineteen healthy men (24.6±4 years, 79.6±7.2 kg, 182.3±6 cm) were matched to an IPC (IPCG) (n=10) or control group (CG) (n=9). The exercise protocol consisted of bilateral biceps curls with a barbell, for 3x10 repetitions at 80% of the concentric 1RM. In IPCG, IPC was applied bilaterally by a tourniquet (200 mmHg) immediately prior to the exercise and consisted of 3x5 minutes of non-lethal ischemia, separated by 5 minutes of reperfusion. The following measures were performed prior to the IPC intervention, as well as pre-exercise, post-exercise and 20 minutes-, two hours-, 24 hours-, 48 hours- and 72 hours post-exercise: Serum Creatine Kinase (CK), arm circumference and subjective pain by VAS (0-100) and the contractile properties of the biceps brachii muscle (radial displacement; Dm) by tensiomyography.

Results

CK activity differed significantly from baseline only in CG at 48h (10032.4±15888.6 U/L, $p<0.001$) and 72h (24316.0±18752.4 U/L, $p<0.001$) post-exercise. After 24h, 48h and 72h, CK concentrations in CG were significantly larger when compared to IPCG (between groups: 24h: $p=0.004$, 48h: $p<0.001$, 72h: $p<0.001$). Furthermore, measurements of perceived pain were significantly higher in CG on all three post-exercise days (24h: 28±16 mm; 48h: 38±14 mm; 72h: 32±15 mm), when compared to IPCG (24h: 5±3 mm; 48h: 7±4 mm; 72h: 3±3 mm; between groups all $p<0.001$). Dm was significantly decreased on all post-exercise days CG (Pre: 11.6 ±3.9 mm; 24h: 9.0±3.6 mm; 48h: 8.3±3.1 mm; 72h: 8.4±3.9 mm; all $p<0.001$) but remained statistically unchanged in IPCG (Pre: 13.8±2.6 mm; 24h: 12.5±2.1mm; 48h: 12.9±1.61 mm; 72h: 13.5±2 mm). The between-group difference was significant ($p<0.01$).

Discussion

The present study indicates that IPC applied immediately prior to an intensive bout of eccentric exercise of the elbow flexors may blunt the skeletal muscle damage and exercise-induced subjective pain, while maintaining the contractile properties of the muscle. Future studies should investigate whether this short-term effect can be reproduced in long-term training studies and whether blunted inflammatory responses possibly compromise optimal neuromuscular adaptations.

ADAPTATIONS AND MUSCLE DAMAGE PROTECTION CONFERRED BY 4-WEEK ECCENTRIC OVERLOAD TRAINING PROGRAM

ILLERA-DOMINGUEZ, V.1, NUELL, S.1, ALOMAR, X.2, CARMONA, G.1, PADULLÉS, J.M.1, LLORET, M.1, CUSSÓ, R.3, CADEFAU, J.A.1,3

1:INEFC-UB (BARCELONA, SPAIN); 2: CREU BLANCA (BARCELONA SPAIN) 3:DEP. BIOMEDICINE I, UNIVERSITY OF BARCELONA (BARCELONA, SPAIN)

Introduction
A single bout of eccentric-biased exercise confers a protective effect against exercise induced muscle damage (EIMD) from a subsequent bout of similar activity (1). The aim of this study was to assess the protective effect of a 4-week eccentric overload training program when intensity of exercise loads is readjusted to the improved force-generating capacity.
Methods
Six physically active students (age: 21.7±2.2 years) completed 10 inertial resistance training sessions during 4 weeks. Each session consisted of 5 sets of 10 reps of maximal bilateral squats performed on a YoYo Squat inertial device. Subjects performed the concentric phase of the movement at their maximum voluntary speed. Force, speed and power (measured with rotational encoder), and maximal voluntary isometric contraction force (MVC) of knee extensors were measured before and after the training period to assess adaptations. To compare muscle response to stress, one week before (BE) and one week after (AF) the training period, single strenuous sessions of exercise were performed. BE and AF sessions comprised the double of volume of a training session (10 sets of 10 reps). Given the characteristics of the training system, each repetition, and thus the exercise bouts were maximal at both temporal points. A follow-up of the volunteers was performed before and 1, 24, 48 and 144 hours of passive recovery after exercise. Parameters measured included indirect markers of EIMD as Blood serum biomarkers (CK & CK-MB), and MVC of knee extensors.
Results
Flywheel resistance training significantly increased MVC levels by 24.0±17.6%. All performance variables of squat exercise improved significantly from BE to AF exercise bouts.
Significant decreases in MVC were seen in the hours following the BE exercise bout, which were not recovered up to 144 hours (-17.1±11.7%). No significant changes in MVC values were seen after AF. An attenuated response of blood biomarkers was seen after AF.
Discussion
Despite working with maximal resistances ≈30% more intense in AF as compared to BE, the different markers assessed suggest the presence of moderate EIMD after BE, but mild/non-existent EIMD following AF (2). Flywheel resistance training is a powerful tool to prevent muscle from EIMD after eccentric contractions, even when the stimulus is readjusted to the current maximal capabilities.
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Contact
villera@gencat.cat

Invited symposia

IS-BN06 NEW INSIGHTS IN BIOMECHANICS OF MUSCLE CONTRACTION

NEW INSIGHTS IN MUSCLE MICROSTRUCTURE AND FORCE GENERATION

RODE, C.

FRIEDRICH-SCHILLER-UNIVERSITY JENA

This talk updates our current view of muscle contraction with two recent theories. The first deals with the possible role of titin in explaining history effects associated with stretching or shortening of the active fiber. The mechanism by which titin can play this role will be explained and predictions of the model are compared with available data. The second theory is concerned with muscle fibre contraction especially at short lengths that is associated with so far unexplained phenomena. The conceptual model of striated fiber contraction indicates that myosin filaments slide through the meshed Z-discs instead of hitting them and being compressed during ongoing shortening. The model predicts the fibre's entire force length behaviour and yields plausible explanations e. g. for the basic Z-disc structure and for the task of the second myosin head. The proposed extension of the sliding filament theory explains a large number of experimental results and offers various testable hypotheses.

MULTIDIMENSIONAL MODELS FOR PREDICTING MUSCLE STRUCTURE AND FASCICLE PENNATION

WAKELING, J.M.

SIMON FRASER UNIVERSITY

When muscle fascicles shorten they must expand in girth in order to maintain their volume. This transverse expansion leads to the pennation angle increasing. The thickness of the muscle represents a balance between the decreasing length that would cause a thinning of the muscle belly, and the increasing pennation that would cause a thickening of the belly. The exact nature of the muscle bulging also depends on the stress distribution throughout the muscle tissue that can be asymmetric in pennate muscle.
Most Hill-type muscle models, that are ubiquitously used for modeling and simulations in biomechanics, assume that the thickness of the muscles are constant. However, experimental results show that substantial bulging of the muscles can occur during contractions.
This presentation will explore the fundamental constant-thickness assumption and the implications it has on understanding structure and predicting muscle force and function. A multidimensional model capable of simplifying the structural representation to 1D, 2D and 3D forms was tested against measured muscle geometries. The 3D representation predicted pennation more accurately. However, it is suggested that the additional complexity and requirement for muscle-specific coefficients render this model to have no practical advantage over the commonly used 1D formulations if the purpose of the structural model is to predict pennation.

INFLUENCE OF MUSCLE COMPRESSION ON MUSCLE FORCE: EXPERIMENTATION AND SIMULATION

SIEBERT, T.

UNIVERSITY OF STUTTGART

Unidirectional transversal compression depresses longitudinal force development in skeletal muscles. The magnitude of this depression depends on the transversal load, not the local pressure associated with this load. This indicates that the active muscle structure is relatively stiff compared with unidirectional transversal loads expected in everyday tasks. Possible mechanisms of the substantial decrease in longitudinal muscle force seem to be related to increased internal pressure, to deformation of the myofilament grid leading to decomposition of crossbridge forces and possibly to inhibition of cross-bridges. Deformation of passive elastic structures is less likely to be a major source of longitudinal muscle force decrease under unidirectional transversal compression. The interactions between the muscle and its mechanical environment could be reproduced with a simple rheological muscle model. This is of interest for interpretation and understanding of three-dimensional muscle function.
Considering that most muscles are packed within other muscles, it may be speculated that muscle architecture minimizes mutual transversal loading within muscle groups or leads to homogenous transversal pressure in all directions for inner muscles. Thus it seems of importance to examine the intermuscular pressure in muscle groups and three dimensional muscle deformations during contraction in more detail.

Oral presentations

OP-PM13 Cardiovascular physiology

BRAIN GREY MATTER VOLUME AND CEREBRAL HAEMODYNAMIC AND METABOLIC RESPONSES TO EXERCISE: IMPACTS OF AGE AND CARDIORESPIRATORY FITNESS

HALE, A.1,2, VAN LIESHOUT, J.J.2, GOWLAND, P.1, GREENHAFF, P.L.1,2, FRANCIS, S.1

1: SIR PETER MANSFIELD IMAGING CENTRE, (NOTTINGHAM, UK), 2: MRC/ARUK CENTRE FOR MUSCULOSKELETAL AGEING RESEARCH, (NOTTINGHAM, UK)

Introduction
Low cardiorespiratory fitness (CRF) is a major global risk factor for all-cause mortality (Blair et al., 1989) and CRF has been positively associated with grey matter volume in older adults (Erickson et al., 2014). Negative health traits attributed to ageing are associated with decreased physical activity levels, and can be positively modified by increased physical activity. Here, we studied healthy young and older subjects using magnetic resonance imaging (MRI) to assess: (1) changes in cortical haemodynamic responses (cerebral blood flow (CBF) and regional perfusion and oxygenation (blood oxygen level dependant (BOLD)), brain oxygen extraction fraction (OEF) and cerebral metabolic rate of oxygen (CMRO2) during low and moderate intensity large muscle group exercise. (2) Grey matter (GM) volume and its relationship with CRF and age.
Methods
27 healthy male subjects were recruited to young (N=12, 21-27 years, BMI 23.5±1.8 kg/m2) and older (N=15, 58-74 years, BMI 23.3±2.0 kg/m2) groups. MR data was acquired at rest, during 10min of supine steady-state cycling exercise at 30% and 50% supine VO2max, and during recovery inside a 3T MRI scanner.
Results
At rest, there was no difference in GM volume corrected CBF between age groups. During exercise, there were clear differences in CBF, perfusion and BOLD between young and older subjects, with blunting of CBF (30% VO2max, $p=0.05$; 50%VO2max, $p = 0.001$) and perfusion (30% VO2max, $p<0.01$; 50% VO2max, $p<0.01$) responses and no clear BOLD response in older subjects. OEF was greater in older subjects compared to young across the exercise task (overall age effect $p=0.0018$, significant at rest and recovery ($p<0.05$)), with a trend for blunting of CMRO2 in old versus young at 50% VO2max. GM volume positively correlated with VO2max across all subjects (Pearson $R=0.776$, $p<0.001$).
Discussion
Brain cortical haemodynamic deficits with age became apparent on exercise, even after correcting for GM volume. We hypothesise that age related deficits in cardiac output, together with muscle steal on exercise, compromise brain perfusion. The trend for blunting of CMRO2 at 50% VO2max in older versus younger subjects suggests that the greater OEF in the older subjects does not fully compensate for their lower CBF at this workload. VO2max was positively related to GM volume across all ages supporting a causative association between habitual physical activity levels and/or CRF and GM volume. These findings have important implications to brain health with ageing.
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Contact
ppxah2@nottingham.ac.uk

DAILY REMOTE ISCHEMIC PRECONDITIONING IMPROVES SYSTEMIC VASCULAR FUNCTION IN TYPE 2 DIABETES MELLITUS

MAXWELL, J.D., CARTER, H.H., HELLSTEN, Y., CUTHBERTSON, D.J., SPRUNG, V.S., THJISSEN, D.H., JONES, H.

LIVERPOOL JOHN MOORES

Introduction
Cardiovascular and cerebrovascular disease are main causes of mortality in type 2 diabetes mellitus (T2DM). Daily remote ischaemic preconditioning (RIPC), induced by using an inflated blood pressure cuff on a limb to induce 4 brief periods of ischaemia, improves endothelial function in healthy individuals (Jones et al., 2014) and reduces the risk of ischemic stroke reoccurrence (Meng et al., 2015). Nevertheless, the impact of daily RIPC on endothelial function and cerebral autoregulation (i.e. brains ability to control its own flow inde-

pendently of changes in blood pressure) in individuals at risk of cardio and cerebrovascular disease is unknown. We hypothesised that 7-day daily RIPC improves endothelial function and cerebral autoregulation in T2DM.
Methods
Eight people with T2DM were randomly allocated into 7-day, daily upper-arm RIPC or control. RIPC was applied unilaterally using a rapid cuff inflator (4x5 min cycles of occlusion at 220mmHg interspaced by 5 min reperfusion). Measurements of cerebrovascular and conduit function were performed pre, post and 8 days post-RIPC intervention (Post 8). Middle cerebral artery velocity (MCAv; Transcranial Doppler), end tidal partial pressure of CO2 (PETCO2) and mean arterial blood pressure (MAP) (Finometer) were continuously measured at rest and throughout manipulation of MAP with squat-stand manoeuvres (6 squats/min) to assess cerebral autoregulation (transfer function). Brachial artery flow mediated dilation (FMD) was also assessed. Data were analysed using repeated measures general linear modelling.
Results
Resting MCAv, PETCO2 or MAP did not change. Cerebral autoregulation improved following the daily RIPC intervention (low frequency gain decreased by 0.11±0.10 cm-1.mmHg-1) and remained more efficient at post 8 (low frequency gain 0.07±0.05 cm-1.mmHg-1 lower; P=0.02). The synchronicity of changes in MCAv and MAP during squat-stands improved (increase in phase), but this did not reach statistical significance. There was also evidence of enhanced FMD after daily IPC (1.9±3.1% increase), which remained elevated by 4.9±4.2% (change pre to post 8). There were negligible changes in the control group.
Discussion
These findings indicate that 7-day daily RIPC improves cerebral autoregulation and enhances endothelial function in individuals with T2DM, which has significant potential for future cardiovascular and cerebrovascular clinical benefits.
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SIMILARITY BETWEEN CAROTID AND CORONARY ARTERY RESPONSES TO SYMPATHETIC STIMULATION AND THE ROLE OF ALPHA-1 RECEPTORS IN HUMANS

VAN MIL, A., TYMKO, M., KERSTENS, T., STEMBRIDGE, M., GREEN, D., AINSLIE, P., THIJSSEN, D.
RADBOUD UNIVERSITY MEDICAL CENTER - LIVERPOOL JOHN MOORES UNIVERSITY - UNIVERSITY OF BRITISH COLUMBIA

Introduction
Exercise has beneficial effects on reducing the risk on cardiovascular disease, partly through the direct effects on the vasculature. Development of novel tests to examine vascular function, especially that from central arteries, is important to further understand the impact of exercise training on cardiovascular risk. The carotid artery reactivity (CAR) test examines carotid vasomotor responses to sympathetic activation and has strong similarity with coronary arteries. To better understand similarity between these arteries, we examined coronary and carotid artery responses to different sympathetic tests, and explored the role of α1-receptors in mediating these vasomotor responses.
Methods
In a randomised order, 10 healthy participants (25±3 years) underwent sympathetic stimulation using either the cold pressor test (CPT; 3-minutes left hand immersion in ice-slush) or lower-body negative pressure (LBNP). Before and during sympathetic tests, CCA diameter and velocity (Doppler ultrasound) and left anterior descending (LAD) coronary artery velocity (echocardiography) were recorded across 3-min. Measures were repeated 90-min following selective α1-receptor blockade via oral Prazosin (0.05 mg per kg body weight).
Results
CPT significantly increased CCA diameter, LAD maximal velocity and velocity-time integral area-under-the-curve (all $P<0.05$). In contrast, LBNP resulted in a decrease in CCA diameter, LAD maximal velocity and VTI (all $P<0.05$). Changes in CCA diameter and LAD VTI-responses to sympathetic stimulation were positively related ($r=0.66$, $P<0.01$). Following the α1-receptor blockade, the CCA and LAD velocity responses to CPT were abolished. In contrast, during LBNP (-30 mmHg), α1-receptor blockade did not alter CCA or LAD responses.
Discussion
Carotid and coronary arteries demonstrate dilation during CPT, whereas both show constriction during LBNP. Following α1-receptor blockade, CPT-induced changes were abolished, whilst LBNP responses were unaltered. These data indicate strong similarity between CCA and LAD responses to sympathetic tests, with between-artery agreement in the direction of change as well as the role of α1-receptors mediating these responses. This provides strong potential for using this simple test to evaluate the role of exercise on the health of central artery function.

LEG BLOOD FLOW AND SKELETAL MUSCLE MICROVASCULAR PERFUSION RESPONSES TO EXERCISE IN PERIPHERAL ARTERIAL DISEASE

MENESES, A.L.1, BAILEY, T.G.1, NAM, M.2, KRASTINS, D.1, MAGEE, R.2, SCHULZE, K.3, GOLLEDGE, J.4, GREAVES, K.2, ASKEW, C.D.1
1.UNIVERSITY OF THE SUNSHINE COAST-AUSTRALIA 2.SUNSHINE COAST HOSPITAL AND HEALTH SERVICE-AUSTRALIA 3.SUNSHINE VASCULAR CLINIC-AUSTRALIA 4.JAMES COOK UNIVERSITY AND THE TOWNSVILLE HOSPITAL-AUSTRALIA

Introduction
Peripheral arterial disease (PAD) is characterised by limited blood flow to the lower limbs secondary to atherosclerosis-related occlusions of the conduit arteries. The effect of these occlusions on the skeletal muscle microvascular blood flow (perfusion) is not well described. We aimed to compare leg blood flow and microvascular perfusion in PAD patients and healthy control (CON) participants at rest and in response to leg exercise.
Methods
PAD (n=12, 69±9 years, ABI: 0.69±0.20) and CON (n=12, 68±7 years) participants completed two 5-min bouts of intermittent isometric plantar-flexion exercise (Intensity: 500N [61±19% max force]; contraction:rest = 2:3s). Resting and contraction-by-contraction calf blood flow were measured using strain gauge plethysmography. Data were fitted to a biphasic exponential curve to determine the kinetic parameters of the exercise response. Microvascular perfusion of the medial gastrocnemius muscle was assessed at rest and immediately following exercise using contrast-enhanced ultrasound. Image intensity data were fitted to a time-intensity exponential growth curve to determine microvascular perfusion (=microvascular blood volume x velocity).

Results
Resting leg blood flow (PAD: 2.22±1.00; CON: 1.96±0.85 ml.100ml-1.min-1; p=0.52) and microvascular perfusion (PAD: 0.19±0.19; CON: 0.09±0.05 aU/sec; p=0.12) were not significantly different between groups. While the total rise in leg blood flow was similar between groups (PAD: +27.98±8.41; CON: +31.39±8.68 ml.100ml-1.min-1; p=0.23), the blood flow kinetics were slower in PAD with a smaller initial rise in blood flow (phase-1), and a slower phase-2 response (p<0.05). Microvascular perfusion following exercise was significantly increased in PAD (+2.25±0.68 aU/sec) and CON (+1.22±0.43 aU/sec) compared to baseline, and tended to be higher in PAD following exercise (p=0.09). There was a trend (p=0.07) for a greater change in microvascular volume in PAD (+9.74±2.50 aU) than CON (+3.77±1.06 aU), with no significant differences in microvascular velocity between groups (p=0.55). The area under the time-intensity curve was greater in PAD (669±500 aU/sec) than CON (262±226 aU/sec; p<0.01).
Discussion
During plantar-flexion exercise PAD patients demonstrated slower leg blood flow kinetics, but tended to have greater microvascular perfusion than CON participants. Microvascular perfusion responses to exercise may be enhanced in PAD so as to maintain local oxygen/nutrient delivery under conditions of limited conduit flow.

HIGH-INTENSITY INTERVAL TRAINING: POTENTIAL ALTERNATIVE TO MODERATE AEROBIC EXERCISE ON HEMODYNAMIC PARAMETERS AT REST AND DURING STRESS TESTING

KETELHUT, S.1, MILATZ, F.2, HEISE, W.3, KETELHUT, R.3,4

1MARTIN-LUTHER-UNIVERSITY HALLE-WITTENBERG, HALLE (SAALE), 2GERMAN RHEUMATISM RESEARCH CENTER, BERLIN, 3CHARITÉ UNIVERSITÄTSMEDIZIN BERLIN, 4MEDICAL CENTER BERLIN, BERLIN

Introduction
Exercise recommendations for prevention and management of cardio-metabolic risk factors have long considered moderate-intensity continuous exercise (MICE) as the most effective treatment. Lately high-intensity interval training (HIIT) is discussed as a potential alternative to MICE not only for improving cardio-respiratory fitness but, moreover, in prevention of cardiovascular diseases (Kessler et al. 2012). The present study compared the acute effects of a single bout of MICE and HIIT on peripheral and central blood pressure (BP) and pulse wave velocity (PWV) as markers of arterial compliance. Since recent studies underline the predictive value of BP regulation during stress (Hu et al. 2015) we assessed parameters during a standardized stress testing as well.
Methods
In a randomized cross-over design 34 healthy male participants (34±8 yrs, BMI 24±2 kg/m2) performed a HIIT (98% wattmax, 6x1min, loading/rest 1:4) and a MICE (60min. at 65% HFmax) during two separate visits. Peripheral and central BP (pBP, cBP) as well as PWV were obtained non-invasively using Mobil-O-Graph (24h PWV monitor, IEM Germany) before (t0) as well as 45 (t45) and 60 (t60) minutes after exercise. Apart from resting measures, parameters were also registered during a 2 minute cold pressor test (CPT) immediately after t0 and t60.
Results
For both MICE and HIIT significant reductions in pBP, cBP and PWV could still be detected at t45 compared to pre-exercise (P<0.05). Only after MICE, this significant effect persisted up to t60. During CPT after t60, significant reductions of the pBP, cBP as well as the PWV (P<0.05) were found for both exercise regimens compared to pre-exercise CPT.
Discussion
Both acute bouts of HIIT and MICE show beneficial effects on arterial compliance up to 45 minutes post-exercise. Parameters after MICE were still significantly reduced at t60 demonstrating prolonged beneficial effects due to MICE. However, both training regimens are capable in effectively attenuating hemodynamic responses to stress testing. HIIT demonstrates as potential alternative to MICE due to its comparable acute effects despite half of exercise time.
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Contact
sascha.ketelhut@sport.uni-halle.de

ALLOMETRIC MODELLING OF PEAK OXYGEN UPTAKE ENHANCES THE PROGNOSTIC VALUE OF CARDIORESPIRATORY FITNESS FOR PREDICTING ALL-CAUSE MORTALITY IN HEART FAILURE PATIENTS

LOLLI, L., BATTERHAM, A.M., ATKINSON, G.

TEESSIDE UNIVERSITY

Introduction
Both obesity and peak oxygen uptake (VO2peak) are well-established prognostic indicators of morbidity and all-cause mortality. Nevertheless, the allometric relationship between VO2peak and body mass [1] might compromise inferences about risk for clinical events. Therefore, we aimed to examine the impact of body size scaling on the prognostic utility of baseline VO2peak for all-cause mortality in heart failure patients with reduced ejection fraction enrolled in the HF-ACTION trial [2].
Methods
The study sample comprised 1351 men and 542 women. Akaike Information Criterion (AIC) criteria [3] were used to assess the relative quality of i) twelve candidate models for scaling VO2peak to body mass, and ii) separate multivariable Cox proportional hazards models including body mass, body mass index (BMI), treadmill absolute, ratiometric (ml/kg/min), and properly normalised VO2peak, plus time-to-exhaustion (TTE) as primary exposure variables. Each Cox model included age, serum urea nitrogen, symptom stability score, severe mitral regurgitation, smoking status, treatment allocation, and allocation × primary exposure interaction as covariates. Adjusted hazard ratios for time-to-death (95% confidence interval, CI) were derived for a 2-standard deviation increment in each primary exposure variable, representing the effect of a typically high vs. a typically low value of the exposure.
Results
The median follow-up period was 3.0 years (interquartile range: 2.1 to 3.8). In women, ratio scaling of VO2peak had only weak support for predicting mortality, whereas models with normalised VO2peak, TTE, or absolute VO2peak were superior to the other candidate

models and essentially equivalent to each other. The adjusted HR for the normalised VO2peak was 0.28 (0.15 to 0.53), corresponding to a 72% instantaneous relative risk reduction per 2SD increase in VO2peak.
In men, the Cox model with normalised VO2peak was the best of the six candidates. The adjusted HR was 0.26 (0.19 to 0.36), corresponding to a 74% relative risk reduction per 2SD increase in VO2peak. Models including BMI or body mass as the primary exposure had no empirical support.
Discussion
We have demonstrated that allometric scaling of VO2peak by body mass is superior to ratio scaling in a prognostic model. Ratio scaling by body mass might also confound any "fit vs. fat" inferences. Appropriate normalisation of VO2peak for body size differences is paramount for clinicians to make reliable decisions about risk stratification.
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Contacts
L.Lolli@tees.ac.uk

Oral presentations

OP-DTB2 DTB Tennis Award 2

NEW TECHNOLOGIES FOR DETERMINING EXTERNAL AND INTERNAL LOADS IN TENNIS

HOPPE, M., BAUMGART, C., FREIWALD, J.
DEPARTEMENT OF MOVEMENT SCIENCE, UNIVERSITY OF WUPPERTAL, GERMANY

Introduction
Since tennis has evolved to a highly physical demanding sport in all age groups, it is presently vital to monitor external and internal loads for optimizing training and regeneration regimes. Here, three PubMed-listed studies using three new technologies for determining external and internal loads in tennis are presented.
Methods
In the 1st study (Hoppe et al., 2014), global positioning system technology was used to assess external loads regarding running activities of adolescents during play. Therefore, not only velocities, but also accelerations and decelerations were analyzed. In the 2nd study (Hoppe et al., 2016a), global positioning and inertial sensor technologies were used to compare running activities between adolescents and adults in detail, for which also metabolic powers, energy expenditures, and on-court movement directions were computed. The 3th study (Hoppe et al., 2016b) investigated internal loads of two elite players in a comprehensive case study. Therein, capillary blood probes were repeatedly taken to assess microRNA (small noncoding RNA) expression rates and standard physiological markers (heart rate and lactate, CK and urea concentration) in response to play.
Results
The main findings of the three studies were: (1a) Running activities of adolescents were characterized primarily by high accelerations and decelerations, but low velocities; (1b) these patterns did not change during play and (1c) the running activities of winners and losers did not differ. (2a) Differences in running activities between adolescents and adults were found at higher velocities, accelerations, decelerations and metabolic powers and also concerning accelerations toward the backhand corner; (2b) no differences between adolescent winning and losing players were evident overall and (2c) differences between adult winning and losing players were detected regarding accelerations toward the backhand and forehand corners. (3a) The changes of circulating microRNAs of both players differed regarding the experienced physiological stress and underlying fitness level and (3b) the time-course in changes of all standard physiological markers were in both players similar, whereas those of the microRNAs were different.
Discussion
The application of global positioning system, inertial sensor and minimally-invasive microRNA analyses provide new insights into external and internal loads in tennis, and thus, may be useful for optimizing training and regeneration regimes.
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Contact
m.hoppe@uni-wuppertal.de

MEASURES OF LOAD AND INJURY IN TENNIS: ARE THERE RELATIONSHIPS?

GESCHEIT, D.T.1,2, CORMACK, S.J.1, DUFFIELD, R.3, KEMP, J.1, KOVALCHIK, S.2,4, REID, M. 2
1: AUSTRALIAN CATHOLIC UNIVERSITY 2: TENNIS AUSTRALIA 3:UNIVERSITY OF TECHNOLOGY SYDNEY 4: VICTORIA UNIVERSITY

Introduction
The prevalence of injuries in elite tennis is high, thus monitoring factors related to injury risk is important (1). In part, monitoring training volume and intensity in order to manipulate training load is suggested to provide some modification of injury risk in football codes (2). Specifically, profiles of high acute training loads in the context of recent historical training (acute:chronic workload ratio) are suggested to precede injury (3). However, the relationship between acute:chronic workload ratios and injury in elite tennis players remains unexplored. To determine the relationship between acute:chronic workload ratios and subsequent injury in elite tennis players.
Methods
Injury data and internal training loads from nationally ranked, Australian tennis players (n=58m, 43f, 19.12.8y) were obtained from an internal database. Internal training loads were reported as total daily session RPE (RPE multiplied by session duration) (4) including all tennis and gym sessions. Subsequent rolling averages of acute (1, 3, 5, 7 and 14 days) and chronic (7, 14, 21, 28 and 60 days) load values

were then calculated (3). The 25 combinations of acute:chronic load and their ratios were assessed for their association to injury risk via mixed effects logistic regression reported as odds ratios (OR).
Results
The magnitude of all acute-to-chronic ratios was 0.9-1.0. Their injury OR were 0.15-0.62, which represents a 38-85% reduction in injury risk. The largest reduction in injury risk was observed when a 14-day acute and 60-day chronic timeframe was used with a reduced injury risk of 85% (0.15 OR).
Discussion
The sensitivity of assessing injury risk changed in response to the number of days that formed the interpretation of acute and chronic load. However, no ratio was >1 highlighting that acute loads did not exceed chronic loads. Previous research suggests spikes in acute load greater than chronic load can enhance athletic fitness and performance but also increase injury risk (5). Therefore, the acute loads experience by the athletic cohort in this study may be protective against injury but limit their physicality in competition. These findings as well as an understanding of the relationships of training duration, exponentially weighted moving averages of acute and chronic load (6) and individual case studies can help practitioners to prescribe workloads to simultaneously enhance physical capacities and minimise injury risk.
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Contact
dgescheit@tennis.com.au

THE HEALTH BENEFITS OF TENNIS: A COMPARISON OF THE PHYSIOLOGICAL CHARACTERISTICS OF SENIOR PLAYERS AND NON-PLAYERS

JACKSON, M.J.1, AMIRABDOLLAHIAN, F.1, ROCHE, D.M.1, KOEHN, S.1, ALIZADEHKHAIYAT, O.1

1: LIVERPOOL HOPE UNIVERSITY

Introduction
Exercise prescription for older adults should include aerobic, strengthening, and flexibility exercises (Bull et al. 2010). However, few activities can simultaneously promote each of these components of fitness whilst remaining practical for this population. Participation in racquet sports has recently been linked with significant risk reduction in all-cause and CVD mortality (Oja et al. 2016). The aim of the current study was to gain comprehensive knowledge of the health status of senior tennis players.
Methods
Two study groups including 29 senior tennis players (STP) (m=13, f=16, aged 55.1±7.4 yrs) and 15 non-tennis playing controls (CON), currently meeting government guidelines for physical activity (m=7, f=8, aged 51.4±9.9 yrs) were recruited. Both groups completed a range of health measurements including; blood lipid profile, body composition (bioelectrical impedance analysis), carotid-femoral pulse wave velocity (cfPWV), glycaemic control, handgrip strength, and maximal oxygen uptake (VO2MAX). Between group differences in health parameters were analysed by independent samples t-tests; data presented are means ± SD, STP vs. CON respectively.
Results
No significant differences [all $p>0.05$] were found between any of the physiological variables, including handgrip strength (34.6±8.8 vs. 32.6±10.5 kg) and VO2MAX (34.7±7.3 vs. 36.1±7.7 ml/kg/min). Although, both groups displayed favourable total cholesterol (5.2±1.1 vs. 4.9±1.1 mmol/L), HbA1c (5.4±0.3 vs. 5.3±0.3 %), body composition (body fat 24.8±6.8 vs. 27.2±6.7 %), blood pressure (125.1±13.1/76.9±9.6 vs. 127.7±13.3/80.1±8.7 mmHg) and cfPWV (7.0±1.1 vs. 7.0±0.8 m/s) (Vermeersch et al. 2010).
Discussion
In conclusion, the results of the present study are congruent with current recommendations for promoting physical activity in this age group and playing tennis in particular, can be an effective strategy to achieve the associated benefits. This research forms part of a larger cross-sectional study which hopes to elucidate the physiological, biomechanical, nutritional and psychosocial health benefits of playing tennis.
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OPTIMAL COOLING STRATEGIES FOR TENNIS IN HOT/DRY AND HOT/HUMID CONDITIONS

LYNCH, G.1, PÉRIARD, J.2, PLUIM, B.3, BROTHERHOOD, J.1, SCHRANNER, D.4, SCHERER, L.4, KORDER, S.4, JAY, O.1

UNIVERSITY OF SYDNEY

Introduction
Tennis is an intermittent high-intensity sport often played in hot climates, with a significant risk of heat-related illness. With the implementation of extreme heat policies at recent tournaments, player safety is of vital importance and there is a need to find practical solutions to mitigate heat strain. Two studies were conducted to compare the utility of different cooling strategies for reducing physiological strain during simulated tennis match-play in both very hot/dry conditions similar to the Australian Open (AUS Open) and hot/humid conditions similar to the US Open.
Methods
Eighteen trained males (9 AUS Open, 9 US Open) undertook three counterbalanced experimental trials in a climate chamber simulating peak environmental conditions at either the AUS Open (45.0±1oC, 9.0±2.0% RH, 29.4±0.6oC WBGT, 475 W/m2 radiant heat load) or the US Open (36.5±0.4°C, 51.0±1.8% RH), consisting of 4 sets of intermittent running on a treadmill in order to generate match-play oxygen

consumption in elite tennis players (Torres-Luque et al., 2011). During International Tennis Federation (ITF)-mandated breaks (90-s between odd-numbered games; 120-s between sets), either iced towels (ICE), an electric fan with moisture applied to the skin (FANwet), or ad libitum 10 C water ingestion only (CON) was administered. Rectal temperature (Tre) and heart rate (HR) were recorded continuously.
Results
AUS Open: Of the 9 participants, all completed ICE, but 8 completed FANwet and CON. After set 3, Tre was lower in ICE (38.2±0.3oC) compared to CON (38.5±0.5oC; p=0.05). End-exercise Tre was lower in ICE (38.1±0.3°C) and FANwet (38.2±0.4°C) compared to CON (38.8±0.5°C;p<0.05). HR was suppressed in ICE (158±7 bpm) and FANwet (156±9 bpm) relative to CON (167±11 bpm) (p<0.05).
US Open: Of the 9 participants, 7, 5 and 1 completed FANwet, ICE and CON respectively. Due to the number of dropout's comparisons at end-exercise were not possible. Following set 3, Tre was lower (P<0.01) in FANwet (38.4±0.4oC) and ICE (38.7±0.5oC) compared to CON (39.0±0.3oC). Compared to CON (175±19 bpm), HR was lower (P<0.05) in FANwet (163±21 bpm) and ICE (164±22 bpm) by the end of set 2.
Discussion
Both studies found that applying cooling interventions during the mandated breaks in play significantly reduced thermal strain compared to fluid ingestion only. In both US Open and AUS Open conditions, ICE and FANwet were equally effective, however FANwet may be a more practical solution for lower resource settings.
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Contact
glyn4102@uni.sydney.edu.au

EXPLAINING TENNIS PERFORMANCE IN TALENTED TENNIS PLAYERS BY PHYSICAL FITNESS

KRAMER, T., HUIJGEN, B., ELFERINK-GEMSER, M., PION, J., VISSCHER, C.
HAN UNIVERSITY OF APPLIED SCIENCES, THE NETHERLANDS & UNIVERSITY OF GRONINGEN, THE NETHERLANDS

Introduction
To perform well in tennis players' physical fitness is important. Physical fitness is widely measured in practice, however less is known about the relation of physical fitness with tennis performance in youth tennis. Boys and girls mature and develop differently, but does this also differ in relation to tennis performance? Furthermore, it is unknown if physical performance can predict tennis performance at the current age and in the future. The aim of this study is to give insight in the development and the importance of physical fitness in relation to tennis performance in youth tennis.
Methods
Youth players (n = 538, boys and girls) in the age of 10-15 years (U11-U16) were measured cross-sectional as well as longitudinally. Age, maturation, and physical fitness (speed, upper and lower body power, agility), were measured. Tennis performance was measured by using the ranking position on the Dutch national youth ranking list. Regression and multilevel analyses were conducted to analyze the relation between physical fitness and tennis performance as well as its association with maturation. Boys and girls were analyzed separately.
Results
Physical fitness of boys as well as girls improves over age. Regression analyses showed that in boys, maturation had impact on the improvement of physical fitness. More matured boys outscored less matured boys in upper and lower body power. Regression and multilevel analyses showed that higher ranked boys outscored lower-ranked boys in speed, and upper body power in boys U14, but not in U15 and U16. The physical fitness components that were measured in U14 did not predict tennis performance two years later in U15-U16. Regression analyses in girls showed that maturation and lower body power were positive correlated with tennis performance in U14. In U16 later matured girls had better tennis performance than earlier matured girls. High-ranked girls outscored lower-ranked girls on lower-body power, speed, and agility in U14, however physical fitness did not predict tennis performance in U15-U16.
Discussion
In youth tennis, at younger ages (U11-U14) physical fitness showed differences within boys and girls between higher and lower ranked players. Maturation has a relation with tennis performance in youth tennis, however not always the earlier matured are in favor. Physical fitness does not seem to predict future performance in boys or girls. More longitudinal research is needed in what explains tennis performance in youth tennis better by applying a multi-dimensional approach in which for example also psychological skills are investigated.

THE CONTRIBUTION OF VISIUAL AND KINESTHETIC IMAGERY ON LEARNING TENNIS SKILLS FOR NOVICE PLAYERS

HEGAZY, K., ROTH, A., WOLL, A.
KARLSRUHE INSTITUTE OF TECHNOLOGY (KIT)

Introduction
The combination of visual and kinesthetic imagery would be more effective than either type alone because it activates both neural pathways and adds to the information from imagery (Hardy & Callow, 1999). Few studies have been conducted on the practical efficacy of both methods to improve tennis learning. Therefore, the present study aimed to investigate the influence of visual and kinesthetic imagery on learning tennis skills for novice players.
Methods
The study used an experimental design with only posttest, applying both technical practice and visual with kinesthetic imagery for learning forehand, backhand, volley, lob and serve. The session was carried out over the course of 11 weeks in 30-minute training with one session per week. Two different types of mental training were utilized: Observer perspective and visual modality, external perspective and kinesthetic modality. The control group received only technical practice for the same time period. 60 university students participated in the study and were divided into 44 students for the experimental group and 16 students for the control recruited from the Department of Sports and Sports Science, Karlsruhe Institute of Technology, Germany in 2015-2016 the subjects were novice in tennis with ages between 19-20 years old.
Results
The results did not reveal a significant difference in the performance level when compared to the control group in terms of ground strokes, volleys, lobs and technique except for the tennis serve, the results showed a significantly higher improvement compared to the control group, as shown by the Mann Whitney test, the experimental mean rank was 33,41 and p=.031.
Discussion

As predicted, the tennis serve, being a closed motor skill, should be more affected by imagery because it is completely under the athlete's control. Therefore, the athlete can use imagery to visualize it precisely (Coelho et al., 2007). Concerning the rest of open tennis skills, the imagery needs to match their stage of development. As a conclusion, imagery would be complicated for a novice player due to their lack of knowledge of the finer aspects of the skill.

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Oral presentations

OP-PM19 Developing young athletes

A SYSTEMATIC REVIEW OF THE TRAINING SPECIFICITY OF YOUTH STRENGTH AND POWER TRAINING ADAPTATIONS

QUIGLEY, P.1, YOUNG, J.1, LI, Y.1, LOW, J.1, REID, J.1, WHITTEN, J.1, DE LIMA, C.1, HODGSON, D.1, CHAOUACHI, A.2,3, GRANACHER, U.4, BEHM, D.1

1: SHKR-MUN (ST. JOHN'S, CANADA), 2: CNMSS (TUNIS, TUNISIA) 3: AUT (AUCKLAND, NEW ZEALAND) 4: DTMS-UP (POTSDAM, GERMANY)

Introduction
Training specificity has been a hallmark of resistance training. The concept of training specificity indicates that optimal increases in strength or power occur when the training regime resembles the desired movement, angle, velocity, or contraction type. Whereas this concept has been consistently demonstrated with adults, resistance training specificity is not as well documented with youth. Hence, the objective was to analyze the effectiveness of youth strength and power training on strength (i.e. isometric maximal voluntary contractions, 1 repetition maximum) and power (vertical and horizontal jump height, sprint velocity and throws) measures.
Methods
This review included studies that examined youth strength or power training programs of minimum 4 weeks' duration on strength and power measures. A literature search was performed using MEDLINE, Web of Science and Google Scholar databases. The topic was searched using a combination of keywords as well as from the reference lists of identified articles.
Results
The review resulted in 72 strength and 56 power training studies that met the criteria. The average youth strength training program was 12.4 weeks (4-26 weeks), 2.2 +/- 0.5 sessions / week with 6.1 +/- 2.9 exercises employing 2.7 +/- 1.1 sets of 9.8 +/- 4.1 repetitions. The mean youth power training program was similar with 2.2 +/- 0.6 sessions / week, 7.7 +/- 4.9 exercises employing 2.1 +/- 1.8 sets of 9.9 +/- 7.9 repetitions, however, was on average shorter at 8.5 weeks in duration (4-13 weeks). Youth strength training programs demonstrated mean effect size and percentage improvements in strength measures of 1.24 +/- 1.68 (large magnitude) and 26.6 +/- 35.7% respectively, with 0.56 +/- 0.74 (moderate magnitude) and 6.8 +/- 8.6% increases in power measures respectively. Power training programs provided similar improvements as strength training programs for power measures with an effect size of 0.53 +/- 1.1 (moderate magnitude) and 8.3 +/- 14.3% increases, respectively.
Discussion
In conclusion, youth strength training programs provided similar improvements in power measures as power training programs, contradicting the training specificity principle. In general, youth may not possess a sufficient foundation of strength to optimize power training adaptations.
Contact
pj.quigley@mun.ca

THE EFFECTS OF CONCURRENT STRENGTH AND ENDURANCE TRAINING ON MAXIMAL STRENGTH, MUSCLE POWER, ENDURANCE, AND ATHLETIC PERFORMANCE IN THE GENERAL YOUTH POPULATION AND IN YOUTH ATHLETES

GÄBLER, M., PRIESKE, O., HORTOBÁGYI, T., GRANACHER, U.

UNIVERSITY OF POTSDAM

Introduction
Endurance training potentially interferes with the effects of strength training, particularly in trained individuals (Coffey & Hawley, 2016) and if training focusses on muscle hypertrophy and mitochondrial growth (Docherty & Sporer, 2000). In many sports, it is necessary to improve endurance and strength concurrently. The current knowledge in concurrent training comes from studies with adults and may not be generalizable to youth (athletes). Thus, the aim of this systematic review and meta-analysis is to evaluate the effects of concurrent training on maximal strength, muscle power, endurance, and athletic performance in trained and untrained children and adolescents.
Methods
A systematic search was performed in the databases of PubMed and Web of Knowledge. Studies were evaluated for the following criteria. Participants of the study had to be healthy children or adolescents (6-18 y). The training groups of the included studies were categorized as strength (ST), endurance (ET), or concurrent (CT) training. Effect sizes were calculated for each of the groups and corrected for sample size bias. The quality of the included studies was evaluated using the PEDro scale.
Results
Our systematic search identified 11 studies (7 involving athletes) that were eligible to be included in the meta-analysis. Taken together 432 (199 female) subjects participated in these studies, of which 149 (47 female) were athletes. Participants' age ranged from 10.0 to 17.5y. Athletes were involved in swimming (5 studies) or running (2 studies), with a weekly training load ranging from 3 to 11 hours. The quality of the included studies on the PEDro scale ranged from 3 to 6, with a median score of 4. Training induced changes were described within the categories of CT, ST, and ET as mean change (%) and [mean corrected effect size] for the outcomes maximum strength (CT: +19.1% [0.6]; ST: n/a; ET: +5.7% [0.2]), power (CT: +8.2% [0.5]; ST: +5.6 [0.4]; ET: -0.8% [-0.1]), endurance (CT: +4.0% [0.4]; ST: +1.9% [0.2]; ET: +1.3% [0.1]), and athletic performance (CT: +0.7% [0.0]; ST: n/a; ET: -1.72% [-0.3]).
Discussion

The greatest overall gains in performance were observed in the CT groups with trivial to small effect sizes. Apart from one study, the training volume was higher in the CT group. With weekly training volume of up to 11 hours, it seems beneficial to conduct CT compared to single ET or ST in order to enhance performance.
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INTER AND INTRA-SEASONAL VARIATIONS IN ENDURANCE AND MUSCULAR PERFORMANCE IN ELITE YOUTH SOCCER PLAYERS

CONNOLLY, D.1, GUALTIERI, A.1, FERRARI-BRAVO, D.1, SASSI, R.1, RAMPININI, E.2
1) JUVENTUS FC, ITALY 2) MAPEI SPORT RESEARCH CENTRE, ITALY

Introduction
The development of youth soccer players' physical abilities is a key objective for football clubs and necessary for players facing the increasing physical match demands. Performing physiological assessments periodically allows us to track the progress of youth soccer players longitudinally, granting a better understanding of players' physical improvements. This study aimed to examine changes in endurance and muscular performance in elite youth players both inter and intra-season.
Methods
34 elite level youth soccer players were monitored across 3 consecutive seasons, from U15 to U17. The players performed the Yo-Yo Intermittent Recovery Test Level 1 (YYR1), 20 m sprint (ST) and countermovement jump (CMJ) before the preparation period (PRE) and during the competitive season (IN). Differences within and between each season were verified using the one way repeated measure ANOVAs with Bonferroni post-hoc test and effect size (d) calculation.
Results
Significant main effects were found for all variables (all $p<0.001$). Within each season, YYR1 performance improved significantly from PRE to IN ($p<0.001$; d from 1.16 to 1.38). However, during each off-season period, YYR1 performance decreased from IN to PRE ($p<0.001$, d=0.87 and 0.73). Comparing PRE or IN with the same time point of the previous season highlighted significant improvements in YYR1 distances ($p<0.001$, d from 0.59 to 0.89). No differences were recorded for ST between PRE and IN for U15 ($p=0.231$, d=0.18), while ST time improved significantly to IN during U16 and U17 ($p<0.001$, d=0.53 and 0.41). No changes in ST performance were observed during the two off-season periods ($p>0.844$, d=0.04 and 0.02). Significant improvements in CMJ were noted for U15 ($p<0.001$, d=0.50) and U16 ($p=0.002$, d=0.30) comparing IN with PRE. The CMJ performance improved significantly also during the off-season period between U16 and U17 ($p=0.020$, d=0.20).
Discussion
These findings indicate that there is an important training effect related to YYR1 performance, while improvements in ST and CMJ appear to be more linked with the physiological growth of the players. The continued improvement of CMJ performance in the off-season suggests that the development of players' capabilities may be more related to muscular growth than training. The evolution of sprinting capacity in U16 and U17 compared to U15 also supports this theory. These findings may facilitate the understanding of individual players' physical capabilities and assist talent development programs.
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THE EFFECT OF AGE AND MATURITY STATUS ON MOTOR COORDINATION, SPEED AND AGILITY IN ELITE YOUTH SOCCER PLAYERS

ROMMERS, N., LENOIR, M., WITVROUW, E., D'HONDT, E.
VRIJE UNIVERSITEIT BRUSSEL, UNIVERSITEIT GENT

Introduction
This study aimed to investigate the differences in generic and soccer-specific motor coordination as well as speed and agility depending on the maturity status (i.e., early, on time or late) of elite soccer players within the U10 to U15 age categories of Belgian youth academies.
Methods
Measurements were collected in 650 elite male soccer players (U10-U15), including (1) body height and sitting height to determine maturity offset and estimate age at peak height velocity (APHV); (2) generic motor coordination using 3 tests from the Körperkoordinationstest für Kinder (KTK): moving sideways, jumping sideways, balancing backwards; (3) soccer-specific motor coordination using the UGent dribbling test; and (4) speed and agility using a 5m/30m sprint test as well as a T-test. APHV z-scores were used to determine maturity status (i.e., early: $z<-1$; on time: $-1 \leq z \geq 1$; late: $z>1$) within each age group. The variance in test results explained by the different youth academies (N=6) was examined by multilevel modelling including a random factor. Subsequently, 3 MANOVA analyses were executed to evaluate the effects of age and/or maturity status on performance for each cluster of tests.
Results
There was no significant influence of youth academy on the effect of age and/or maturity status for any of the outcome measures ($p>0.05$). (M)ANOVA analyses showed a significant interaction effect for all individual speed and agility tests ($p<0.05$), revealing maturity status related differences in the U14 ($p=0.04$) and U15 ($p=0.013$) age groups. In addition, a significant main effect of age was found for all test clusters and individual tests ($p<0.001$). Post hoc analyses showed significant differences ($p<0.05$) between all age groups in the 30m sprint test, the 5m sprint and T-test (except for U12 vs. U13) and the 3 KTK tests (except for U14 vs. U15). The main effect of maturity status reached significance for speed and agility tests ($p=0.025$) and generic motor coordination ($p=0.01$). Further analyses revealed significantly better performance in sprinting (5m: $p=0.001$; 30m: $p=0.003$) in the early mature players and in jumping sideways ($p=0.006$) and balancing backwards ($p=0.02$) in the late mature players independent of age.
Discussion
Firstly, several tests only showed significant differences between specific ages, suggesting the existence of critical ages for skill acquirement to be considered in identifying talented players. Secondly, the results of this study indicate that certain performance tests are not (e.g. UGent dribbling test) or only in a certain age (e.g. T-test) influenced by maturity status (z-score based), which should be considered to counterbalance the varying role of maturity in talent identification and selection procedures.

YOUTH SOCCER AND THE RELATIVE AGE EFFECT: INFLUENCE OF THE CHANGES IN THE TALENT IDENTIFICATION POLICY IN A PROFESSIONAL CLUB

GIL, S.M.1, LEKUE, J.A.1,2, LARRUSKAIN, J.1, RODRIGUEZ-LARRAD, A.1, BIDAURRAZAGA-LETONA, I.1
UNIVERSITY OF THE BASQUE COUNTRY (UPV/EHU)

Introduction
Selection of high level young soccer players is influenced by their relative age (Gil et al., 2014); one of the consequences is the Relative Age Effect (RAE) (Cobley et al., 2009). The aim of this study was to evaluate the effect of a new talent identification strategy for young players in a professional club. Specifically, the new policy tried to identify players born at the end of the year to diminish the discrimination against young players.
Methods
We compared the data of 66 outfield male players (9-10 years old), selected to enter the Athletic Club in three seasons 2012-13 (n=16), 2013-14 (n=18) and 2016-17 (n=32). For the 3rd season, the club had the particular objective of identifying more players born late in the year. The date of birth (year divided in two semesters), velocity 15-m, Barrow´s agility test, Yo-Yo IR1 and CMJ were recorded. Chi squared test and ANOVA were performed to compare players of the three seasons.
Results
Mean age of the players in each season was 10.20±0.29, 10.26±0.29 and 10.14±0.27 years old. The distribution of the birth-dates were 62.5% vs 37.5% in 2012-13, 66.7% vs 33.3% in 2013-14 and 41.9 vs 58.1% for the semesters, respectively.
Players of the 3rd season performed worse than players in the 1st season in the agility test (12.37±0.46s vs 11.69±0.29s, $p<0.001$) and the CMJ (31.45±2.59cm vs 28.45±3.23cm, $p<0.01$).
In the velocity test (6.05±0.17m/s, 5.95±0.18m/s and 5.93±0.18m/s) and the Yo-Yo IR1 (887.5±283.6m, 855.5±294.9m and 864±252.0m) results were similar amongst the 1st, 2nd and 3rd seasons, respectively.
Discussion
A change in the distribution of the date of birth of the young selected players was observed in the 3rd season after the modification of the recruiting policy. In fact, although it was not statistically significant, for the first time more players had been born in the second half of the year compared to the first half. Interestingly, although differences were not observed amongst the players in the velocity and the endurance tests, a worse performance was observed in the agility and the jump tests in the 3rd season, probably due to the relatively younger group. Certainly, it will be interesting to follow this particular group of young soccer players in order to elucidate what happens in the future.
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Contact
e-mail: Susana.gil@ehu.es

RELATIVE AGE EFFECTS IN SWISS TALENT DEVELOPMENT – A NATIONAL ANALYSIS OF ALL SPORTS

ROMANN, M., RÖSSLER, R., JAVET, M., FAUDE, O.
SWISS FEDERAL INSTITUE OF SPORT MAGGLINGEN

Introduction
Relative age effects (RAEs) result in performance discrepancies between children and youth within one selection year (Cobley, Baker, Wattie, & McKenna, 2009). This generates consistent participation inequalities, selection biases and may lead to a drop out of potential talents. The aim of this study was to investigate RAEs across all sports of the national Swiss talent development program (STDP).
Methods
In this study, 18'859 (age range 5 to 20 y; female N = 5'353; mean age: 14.8±2.5 y and male N = 13'506; mean age: 14.4±2.4 y) youth athletes of 70 sports who participated in the 2014 competitive season were evaluated. All data were obtained from the national database of STDP. The sample was subdivided by sex, Olympic vs. non-Olympic sports and regional vs. national level selection (NLS, N=2464). The year was divided into four birth quarters (Q1: Jan. to Mar.; Q2: Apr. to Jun.; Q3: Jul. to Sept.; Q4: Oct. to Dec.). Odds ratios (ORs) and 95% confidence intervals (CI) were calculated for the comparison Q1 vs. Q4.
Results
In the whole STDP sample, youth athletes born in Q1 were 1.84 (95% CI 1.74, 1.95) for males, and 1.35 (95% CI 1.24, 1.47) for females times more likely to be selected than athletes born in Q4. Olympic sports showed higher ORs (males: 1.93 (95% CI 1.82, 2.05), females: 1.37 (95% CI 1.25, 1.5), than non-Olympic sports (males: 1.10 (95% CI 0.89, 1.31), females: 1.17 (95% CI 0.91, 1.5)). RAEs were higher in male NLS (OR 2.40 (95% CI 1.42, 1.97)) and were similar in female NLS (OR 1.30 (95% CI 1.08, 1.57)) compared to the lower selection level. NLS in Olympic sports showed higher ORs for males (2.54 (95% CI 2.11, 2.97)) and for females (1.34 (95% CI 1.09, 1.64)) than non-Olympic sports (males: 1.18 (95% CI 0.69, 1.82), females: 1.14 (95% CI 0.72, 1.8)).
Discussion
In the national Swiss talent development program, RAEs are evident for males and females in most sports. These results support existing literature demonstrating that popular Olympic sports show higher RAEs than non-Olympic sports and that RAEs are higher in males than females (Cobley et al., 2009). Higher selection level showed higher RAEs only for males. RAEs reflect a type of developmental barrier that may be preventable by implementing appropriate solutions in the future (Romann & Cobley, 2015). Especially for a small nation like Switzerland, with correspondingly few sport talents, any future reduction of RAEs may provide a substantial performance enhancement at elite senior level.
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Oral presentations

OP-PM64 Training in the elderly

MUSCLE WASTING IS THE PRIMARY CAUSE OF WEAKNESS IN 'HEALTHY' AGEING, WITH MODEST-TO-NEGLIGIBLE CONTRIBUTIONS OF REDUCED MUSCLE QUALITY, NEURAL ACTIVATION AND ARCHITECTURAL REMODELLING

MCPHEE, J.S. JONES, D.A. DEGENS, H.

MANCHESTER METROPOLITAN UNIVERSITY

Introduction
It remains unclear whether declining muscle quality, generally defined as force per unit muscle mass, or muscle quantity are the main determinants of weakness in old age, possibly due to differences between studies in the technique used to estimate muscle size.
Methods
To investigate, 31 young and 40 older men and women (mean age young 23yrs; old 72 yrs) provided written informed consent to participate in the study. Participants completed: DXA to estimate thigh lean mass; MRI to estimate thigh and quadriceps muscle volumes and patella tendon moment arm; ultrasound to determine quadriceps fascicle length and pennation angle. Knee extensor maximal voluntary contraction torque (MVC) and voluntary activation were measured using the twitch interpolation technique.
Results
MVC torque and patella tendon force in old were 63% and 61%, respectively, of the values for young. Multiple linear regression analysis showed that muscle size (thigh volume, quadriceps volume or physiological cross sectional area all gave the same result) explained 78% of variation in MVC torque, with only modest contributions from in vivo specific force (13%). When using measurements of muscle size from DXA rather than MRI, thigh lean mass explained a little over half of the variation in MVC torque (58%) and muscle "quality" measured as torque normalised to lean mass explained just over a third (36%). In both models, voluntary activation, moment arm and muscle architecture each contributed negligibly, less than 2%.
Discussion
These results show that muscle wasting is the primary cause of weakness in 'healthy' older men and women, with modest-to-negligible contributions of reduced muscle quality, neural activation and architectural remodelling. Results from DXA provide misleading information.

A HEATLHY DIET RICH IN N-3 PUFAS ENHANCES THE EFFECTS OF RESISTANCE TRAINING IN ELDERLY WOMEN

EDHOLM, P., STRANDBERG, E., KADI, F.

SCHOOL OF HEALTH AND MEDICAL SCIENCES

Introduction
Aging is associated with a gradual loss of muscle mass and muscle function which contributes to a progressive loss of independence and the deterioration in quality of life. A strong predictor of functional status in elderly is the ability to rapidly generate muscle force (i.e. explosive capacity). Currently, resistance training is well established as an effective strategy to delay the age related decline in muscle mass, maximal muscle strength and explosive capacity. In addition, recent data suggest beneficial effects of n-3 polyunsaturated fatty acids (n-3 PUFAs) as a therapeutic agent to reduce the age related decline in muscle mass and maximal muscle strength (Smith et al., 2015). The aim of the current randomized controlled trail was to investigate the effects of resistance training combined to a whole-diet approach rich in n-3 PUFAs on l explosive force capacity and physical function in elderly women.
Methods
63 healthy elderly women (65-70yrs) were randomized into control (CON), resistance training (RT) and resistance training and healthy diet (RT-HD). Progressive resistance training was performed for 24 weeks at a load of 75%-85% 1 RM. The healthy diet was based on current dietary guidelines in Europe and US, i.e. rich in wholegrain products, vegetables, fruits and fish with the following major adjustment: the n-6/n-3 ratio < 2.
Results
Whole-body lean mass increased significantly by 1.5 ± 0.5% in RT-HD only. Isometric knee extension strength, timed-up-and-go and single-leg-stance performance increased similarly in RT and RT-HD. Improvements in dynamic knee extension peak power and time to reach peak power (i.e. shorter time) occurred in both RT (+15.7 ± 2.6% and -11.0 ± 3.8%) and RT-HD (+24.6 ± 2.6% and -20.3 ± 2.7%) with the magnitude of changes significantly larger in RT-HD. Similarly, changes in squat jump peak force and rate of force development were higher in RT-HD (+58.5 ± 8.4% and +185.4 ± 32.9%) compared to RT (+35.7 ± 6.9% and +105.4 ± 22.4%).
Discussion
The current study present novel results showing that a healthy diet rich in n-3 PUFAs can optimize the effects of resistance training on lean mass and dynamic explosive force capacity in healthy elderly women.
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Contact
peter.edholm@oru.se

EFFECTS OF SUPERVISION OF BALANCE AND STRENGTH TRAINING INTERVENTIONS ON BALANCE AND MUSCLE STRENGTH IN OLD ADULTS: A META-ANALYSIS

LACROIX, A.1,2, HORTOBAGYI, T.3, BEURSKENS, R.1,2, GRANACHER, U.1

1: UNIVERSITY OF POTSDAM (POTSDAM, GERMANY), 2: AGAPLESION BETHANIEN HOSPITAL GGMBH (HEIDELBERG, GERMANY), 3: UNIVERSITY OF GRONINGEN (GRONINGEN, THE NETHERLANDS)

Introduction
Balance (BT) and resistance training (RT) can improve balance and muscle strength in healthy old adults (Granacher et al., 2011). Delivering such programs without supervision could reduce costs. So far, no meta-analysis has been conducted to elucidate whether super-

vised and unsupervised interventions are equally effective. Thus, the aim of this meta-analysis was to quantify the effectiveness of supervised versus unsupervised BT and/or RT programs on measures of balance and muscle strength in old adults.
Methods
A systematic literature search was performed to detect articles examining the role of supervision in BT and/or RT in old adults. Studies were included, if they examined BT and/or RT in adults aged 65 and older with no relevant diseases and registered at least one behavioral balance (e.g., time during single leg stance) and/or muscle strength/power outcome (e.g., time for 5-Times-Chair-Rise-Test). Finally, 11 studies were eligible for inclusion. Weighted mean standardized mean differences between subjects (SMDbs) of supervised versus unsupervised BT/RT studies were calculated.
Results
Supervised BT/RT was superior compared to unsupervised BT/RT in improving measures of static/dynamic steady-state balance, proactive balance, balance test batteries, and measures of muscle strength/power (SMDbs: 0.24-0.53). Effects in favor of supervised programs were larger for studies that did not include any supervised sessions in their unsupervised programs (SMDbs: 0.28-1.24) compared to studies that implemented a few supervised sessions in their unsupervised programs (e.g., three supervised sessions throughout the program; SMDbs: −0.06-0.41).
Discussion
Supervised BT and/or RT improved measures of balance and muscle strength to a greater extent than unsupervised programs. Due to the small number of eligible studies, findings have to be interpreted with caution. However, the positive effects of supervised training are particularly prominent when compared to completely unsupervised training programs. We therefore recommend to include supervised sessions (i.e., two out of three sessions) in BT/RT programs to effectively improve balance and muscle strength/power in old adults. Future research of high methodological quality is needed to confirm our findings and to clarify possible reasons for why unsupervised interventions are less effective, potentially offsetting any presumed cost sparing.
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Contact
andre.lacroix@gmx.de

THE TIME COURSE OF MUSCLE MORPHOLOGICAL AND ARCHITECTURAL ADAPTATIONS TO MODERATE-LOAD CONCENTRIC AND ECCENTRIC TRAINING IN YOUNG AND OLDER MEN

FRANCHI, M.V., QUINLAN J.I., PHILLIPS, B.E., ATHERTON, P., SMITH, K., SZEWCZYK, N., GREENHAFF, P., NARICI, M.V.
UNIVERSITY OF NOTTINGHAM

Introduction
Moderate eccentric (ECC) loading has been recently advocated as an efficient way to achieve increases in muscle mass (1,2). We previously reported that concentric (CON) vs. eccentric (ECC) resistance training leads to similar hypertrophy but with distinct changes in fascicle length and pennation angle (3). Here we investigated the extent and the time course of the muscle morphological and structural remodeling to moderate ECC vs. CON loading in young and older men.
Methods
Twenty-four healthy volunteers (12 young, 19-30 yrs, and 12 elderly, 65-73 yrs) were recruited after informed consent and ethical approval. Data are reported as mean±SEM, statistical significance was assessed using a two way ANOVA. Young and elderly subjects were randomly assigned to either an ECC (n=6) or CON (n=6) RT group: volunteers were trained 3 times/wk for 8 wks (12-15 reps x 4 sets) at the 60% of either the ECC or CON 1RM. Changes in vastus lateralis (VL) architecture (fascicle length –Lf, and pennation angle –PA) were assessed by ultrasound technique. Quadriceps mid-thigh (50% of VL length) cross sectional area (CSA) was measured by extended field of view (EFOV) ultrasound technique. The data acquisition was performed at 0, 2, 4, 6 and 8 wks of the training regime.
Results
In both age groups, architectural adaptations reflected previous findings (2), resulting in contraction-specific responses (i.e. Lf significantly increased after ECC, while PA showed greater increase after CON RT). However, younger ECC group showed a faster and greater increase in Lf compared to the ECC elderly group since 2 weeks from the start of the protocol (Δ %increase = 2.84±0.92, P<0.001), which was maintained at 4,6 and 8wks (Δ %increase = 2.26±0.1, P<0.05; 2.3± 0.25, P<0.05; 2.73±0.18, P<0.01; respectively). Nor the Lf time course for CON groups or the time course of PA (ECC young vs. old and CON young vs. old) presented significant differences. CSA showed similar increase and time course pattern to same loading type across ages (ECC or CON young vs. old): however, in elderly subjects, ECC presented a greater CSA increase at 4 and 6 wks compared to CON (Δ %increase = 2.7±0.5, P<0.05; 2.6±0.8, P<0.05; respectively).
Discussion
Thus, even in the elderly, architectural adaptations to moderate-load exercise are contraction-specific. However, structural changes were achieved earlier and in a greater amplitude by moderate ECC loading in young compared to older men. In older men, the more rapid increase in muscle CSA in response to ECC indicates that moderate ECC loading could be a more time-efficient hypertrophic stimulus than moderate CON RT.
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AEROBIC EXERCISE ON BRAIN PERFUSION AND COGNITION IN AMNESTIC MILD COGNITIVE IMPAIRMENT DUE TO AD

TEIXEIRA, C.V.L., CAMPOS, B.M., DE CASSANI, A.F.M.C., WEILER, M., MAGALHÃES, T.N., VICENTINI, J., QUEIROZ, D., JOAQUIM, H.P.G., TALIB, L., FORLENZA, O., SILVA, T.Q., DA SILVA, M.P.F.
UNICAMP

Introduction
Increasing evidence demonstrates that physical exercise is an important modifiable factor not only for cardiovascular fitness, but also for brain health and dementia prevention. However, it is not clear how supervised physical exercise can affect cognition and brain perfusion in patients with amnestic mild cognitive impairment (aMCI) due to Alzheimer's disease (AD). In this study, we aimed to evaluate six

months of aerobic training on brain perfusion in aMCI subjects with CSF positive AD biomarkers (low β-amyloid(Aβ)1-42 and/or low (Aβ)1-42/p-tau).
Methods
19 aMCI (mean age of 68,6 ± 5,3 years old) subjects were diagnosed using the core criteria of the NIA/AA for MCI and presented positive CSF AD biomarkers. All patients underwent, pre and post intervention period, neurocognitive tests, which included Mini Mental State Examination (MMSE) and Rey Auditory-Verbal Learning Test (RAVLT), and a MRI scaning at 3.0 Tesla. Arterial Spin labeling (magnetic resonance imaging technique) measured brain perfusion. A graded maximal exercise test on a motor-driven treadmill assessed aerobic fitness (measured by VO2maximun). They all participated in aerobic exercises, for 6 months, 3x/week. Brain perfusion was analyzed using Statistical Parametric mapping (SPM) and IBM SPSS (statistical package) analysed cognitive tests and aerobic fitness.
Results
Paired t Test showed a significant improvement in RAVLT and aerobic fitness ($p=0.009$, $p<0.007$). SPM showed an increase in perfusion in both hippocampus (right and left) ($p=0.005$, uncorrected).
Discussion
The present results show that physical exercise may play an important role on improving memory and it may be through the increase in brain perfusion. It is still unclear how exercise-induced changes in levels of growth and neurotrophic factors relate to volumetric and perfusion changes (Duzel et al., 2016) and its influence on cognition. However, it's important to highlight that, physical exercise interventions aimed at improving brain health through neuroprotective mechanisms show promise for preserving cognitive performance (Kirk-Sanchez et al., 2014). Even being our studied patients a high-risk population to develop AD, they benefited from aerobic exercise. Conclusion: Six months aerobic exercise seems to be effective, not only for improving aerobic fitness, but also in memory and hippocampus area perfusion in aMCI subjects due to AD.
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INFLUENCE OF FEAR OF FALLING AND PHYSICAL LIMITATIONS ON GAIT PERFORMANCE UNDER SINGLE AND DUAL TASK CONDITIONS

WOLLESEN, B.1, KÖHLER, B.1, POVOCI, N.2, MATTES, K.1
1UNIVERSITY OF HAMBURG; 2 MACQUARIE UNIVERSITY, SYDNEY

Introduction
The ability to walk safely is one of the key aspects of mobility and independence in old age, as it allows social participation and prevents falls. Therefore it is of great interest to identify the factors that influence gait pattern and may be modified with appropriate training programs (Sherrington et al., 2008).
A fear of falling as well as balance declines have been shown to negatively influence walking performance in older adults (Zijlstra et al., 2007). This study evaluates if and how these factors influence gait kinematics under single (ST) and dual task (DT) conditions.
Methods
N = 223 (female n= 160; male n= 63) participants were examined in: 1. ST: walking; 2. ST cognitive performance: visual-verbal Stroop test; 3. DT: walking + Stroop test. The FES-I and the SPPB were used to analyze the influences on gait kinematics with F-tests (SPSS 22).
Results
ST and DT walking analyzing multiple fall risks led to different peak forces (PF) of the forefoot ($F=4.92$; $p= .028$; $p\eta^2= .041$).
Balance declines influenced the gait line (left: $F=3.81$; $p= .05$; $p\eta^2= .021$; right: $F= 5.44$; $p= .012$) and accompanying PF from ST to DT. Additionally, they increased step width ($F=6.25$; $p= .013$; $p\eta^2= .35$), decreased step length and PF for the forefoot.
Fear of falling increased step width ($F=5.27$; $p= .023$; $p\eta^2= .03$), reduced step length (left: $F=21.801$; $p< .001$; $p\eta^2= .114$; right: $F=22.230$; $p< .001$; $p\eta^2= .116$) and gait line (left: $F=14.180$; $p < .001$; $p\eta^2= .077$; right: $F=15.828$; $p < .001$; $p\eta^2= .085$) and reduced PF in the midfoot and heel. Differences from ST to DT were found for step width and step length.
Discussion
A reduced score on the FES-I had the largest impact on the observed walking parameters. Fall prevention or gait performance studies should integrate training aimed at reducing fear of falling to prove whether or not walking performance or walking stability can be improved. Moreover, the influence of fear of falling on DT cognitive performance should be further analyzed.
In addition, it may be interesting to identify the gait variables that are most modifiable in order to develop future training programs for gait stability and fall prevention for people with a fear of falling.
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Contact
Bettina.wollesen@uni-hamburg.de

Oral presentations

OP-PM41 Occupational aspects of health and physical activity

EFFECTS OF WORK DEMANDS ON ASSOCIATIONS BETWEEN MEASURES OF PHYSICAL FITNESS AND PSYCHO-COGNITIVE PERFORMANCE IN THE YOUNG AND MIDDLE-AGED WORKFORCE

PRIESKE, O., LOOKS, V., GRANACHER, U.

UNIVERSITY OF POTSDAM

Introduction
It has previously been reported that physical fitness is associated with measures of psycho-cognitive performance (Tonello et al., 2014). There is evidence that physically demanding work can affect physical fitness (e.g., endurance; Holtermann et al., 2010) and psycho-cognitive performance (e.g., stress; Wu & Porell, 2000) of the workforce. Thus, the purpose of this study was to examine the effects of specific work demands on the associations of physical fitness and psycho-cognitive performance in the workforce.
Methods
Healthy, young and middle-aged workers (73 men, age = 33±7 yrs; 75 women, age = 35±9 yrs) were recruited from small-to-medium-sized enterprises (e.g., food and insurance companies) in Germany. Participants performed physical fitness tests for cardiovascular endurance (Harvard step test), trunk flexor/extensor muscular endurance (Bourban/Biering-Sorensen test), grip strength (hand dynamometry), balance (single legged stance with eyes closed), and leg muscle power (jump-and-reach test). Additionally, stress (Perceived Stress Scale), cognitive performance (Digit symbol test), and work ability (Work Ability Index) were assessed. Further, the work ability questionnaire was used to classify participants as workers with mental (MD) or physical (PD) demands at work.
Results
Ninety-four workers were allocated to MD (men/women: n=44/50) and 54 to the PD group (men/women: n=29/25). The MD group showed significantly higher levels of balance, trunk extensor muscular endurance, and cognitive performance ($p<.035$, $0.35\leq d\leq 0.55$) but lower levels of stress compared to PD ($p<.023$, $d=0.38$). Group-specific Spearman rank correlation analysis (rS) revealed significant, small-to-medium-sized correlations between physical fitness and cognitive performance ($-.205\leq rS\leq .434$) in MD and PD. Additionally, stress showed significant, medium-to-large-sized correlations with work ability ($.457\leq rS\leq .503$) in both groups. Significant, small-to-medium-sized correlations were found for physical fitness and perceived stress/workability ($.211\leq rS\leq .301$) in MD only. Further, associations of trunk extensor muscular endurance and work ability were significantly higher in MD ($rS=.240$) compared to PD ($rS=-.141$; $z=2.16$, $p=.031$).
Discussion
The present findings imply that higher levels of physical fitness may partly contribute to higher psycho-cognitive performance and/or vice versa. This association appears to be more pronounced in young and middle-aged workers who are confronted with mentally rather than physically challenging everyday working.
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Contact
prieske@uni-potsdam.de

COMPARISON OF ENERGY EXPENDITURE AND MUSCULAR ACTIVITY WHILE SITTING ON A STABILITY BALL VERSUS OFFICE CHAIRS

KUMAHARA, H.1, GORYOZONO, N.1, HIRAYAMA, M.1, MORIMOTO, R.1, AYABE, M.2

1: NAKAMURA GAKUEN UNIVERSITY (FUKUOKA, JAPAN), 2: OKAYAMA PREFECTURAL UNIVERSITY (SOJA, JAPAN)

Introduction
Prolonged sitting has been shown as a cardiometabolic and all-cause mortality risk, independent of physical activity. Furthermore, reducing sitting time may play an important role in increasing daily energy expenditure (EE). In contrast, stability balls (SBs) have become popular and are often used as an alternative to office chairs (OCs). Previous studies have clarified whether SB chairs have the potential in helping to reduce the morbidity of low back pain from the biomechanical aspects (Gregory et al., 2006; McGill et al., 2006; Kingma et al., 2009). However, there is limited evidence regarding the effect of their use on EE. This study aimed to evaluate the differences between sitting on SBs and on OCs in terms of EE and muscular activity.
Methods
Sixteen adults were instructed to sit on four types of chairs in a random order for 10 min each: OC with backrest (OCcont), OC without backrest (OC), OC designed to improve the sitting posture (BJ) and SB. The expired gas, surface electromyogram (EMG) and heart rate of the participants were measured. EMG signals were obtained from two abdominal muscles (rectus abdominis and abdominal internal oblique), two back muscles (lumbar erector spinae and multifidus) and two lower limb muscles (rectus femoris and medial gastrocnemius). The percentage of maximum voluntary contraction in the integrated EMG (%MVC) was also evaluated.
Results
Oxygen consumption (VO2) and heart rate while sitting on SB were significantly increased compared with those while sitting on OCcont (increase in VO2 of 13+/-2% over that with OCcont). The sum of iEMG for all six muscles was significantly larger while sitting on SB than while sitting on OCcont and BJ. The iEMG of the rectus femoris muscle was significantly larger while sitting on SB than while sitting on other three types of chairs. Stepwise multiple regression analysis revealed that the increase in VO2 while sitting on SB was due to the increase in rectus femoris muscle activity ($r2=0.531$, $p<0.05$).
Discussion
Small but significant changes in metabolic responses were observed when the subjects sat on SB compared with those when the subjects sat on OCcont, suggesting that SB use for prolonged sitting may be advantageous for preventing obesity. However, the effect of a small increase in muscle activation, i.e. about 5% MVC of the rectus femoris while sitting on SB, on muscle growth remains unclear. Further studies are needed to explore the long-term effects of using SB at workplace on health.
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Contact
kumahara@nakamura-u.ac.jp

REQUIREMENTS FOR EXERCISES IN PRIMARY PREVENTION FOR STATIONARY NURSING AND GERIATRIC NURSING

OTTO, A., GABRIEL, L., WOLLESEN, B.

UNIVERSITY OF HAMBURG

Introduction
Caregivers have multiple work-related problems such as physical and mental stress as well as time pressure (Michaelis et al., 2015). Back, shoulder and neck pain are especially problematic despite of ergonomic knowledge. In fact some musculoskeletal disorders may also be related to stress at work (Horvath et al., 2015). The implementation of health promotion programs are necessary to reduce these problems. The aim of this study is to analyze whether caregivers in different roles (stationary, ambulant care or trainee) require particular and individualized components in an exercise and health promotion program.
Methods
N=155 caregivers were included in a quantitative survey (KGG, SF-12, TICS, MGV-39). The evaluation was conducted considering the setting (stationary care with geriatric care, ambulant care, trainees in care). The analysis incorporated Chi²-Tests and Analysis of variance (SPSS 22).
Results
There were no significant differences in health status of caregivers. Deviations were found in health control awareness "social externality" (trainees in care; F=3,092, p=0,030, peta²=0,080). Furthermore it became apparent that the different roles involved high stress values, both physical and mental. In addition, the caregivers were adversely affected by high physical demand, stressful body positions, performance pressures and time pressure. Results indicate that participants preferred strength training, endurance training and relaxation training in which deviations were found in strength training (ambulant care; Chi2=11,162; p=0,011, C=0,302).
Conclusions
Health promotion programs are desirable for the reduction of mental stress in combination with ergonomic movement programs (Alexandre et al., 2011). Stationary caregivers and geriatric caregivers require the same programs. Exclusively ambulant caregivers and trainees need to be addressed with different health promotion strategies (e.g. more individual coaching or peer-group orientated).
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Contact
ann-kathrin.otto@uni-hamburg.de

SELF-RATED PHYSICAL LOADS OF WORK TASKS AMONG CERTIFIED NURSING ASSISTANTS

LINDBERG, A.

WINTERNET

Introduction
Working as a certified nursing assistant (CNA) is both physically and mentally demanding [1] and the workload have increased [2]. In Sweden, the sick leave rate is higher among CNAs compared to the overall mean sick leave in the country. Work performance is a multidimensional and dynamic concept specific to the work performed [3], some characteristics that may affect work performance for CNAs are adequate education, ergonomics, stress, adequate technical means, job satisfaction and work capacity. Work capacity has previously been defines as physiological capacities in relation to job requirements [4]. Consequently, a low physical capacity in relation to job requirements may increase the risk of work-related overload and injuries, valuation and prediction of work capacity would be useful in order to prevent overload and injuries caused by a substandard physical capacity. The first step in this process and the aim of this study was to identify CNAs self-rated physical demands for frequently occurring work tasks and to determine if the ratings differed between working units.
Methods
An extensive questionnaire was distributed to 709 CNAs. The questionnaire included background questions and 20 work tasks rated for frequency and physical demands (aerobic capacity and muscle strength in shoulders, back, arms, hands and legs) according to their own experience. Data was analyzed with parametric and non-parametric methods, depending on the data. Work tasks were ranked on the basis of the responses in each category. The Research Ethics Committee for Northern Sweden at Umea University approved the study in October 14, 2014 and the study was conducted in accordance with the WMA Declaration of Helsinki, Ethical Principles for Medical Research Involving Human Subjects 2008.
Results
A total of 694 CNAs represented from five units completed the questionnaire. Their mean age was 45 years (20 to 72). Significant differences were found between units for background questions, rated work task frequencies and physical demands ($p<0.05$). The work tasks rated as the most physically strenuous in terms of aerobic fitness and muscle strength included moving clients, put on stockings, lifting and carrying bulky items and driving a wheelchair.
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IMPLEMENTATION OF A SIX MONTHS WORK-SITE SUPERVISED ADAPTED PHYSICAL ACTIVITY PROGRAM AMONG VINEYARD-WORKERS: LONG-TERM EFFECTS ON TRUNK MUSCLE ENDURANCE, FLEXIBILITY AND PAIN SENSITIVITY

BALAGUIER, R., MADELEINE, P., JADAUD, A., MOUREAUX, E., DIOUM, P., VUILLERME, N.

UNIVERSITY OF GRENOBLE ALPES

Introduction

Work musculoskeletal disorders (WMSDs) affecting the low back are a common work related complaints reported among vineyard-workers. To prevent the risk of such disorders, previous worksite adapted physical activity (APA) programs have been implemented to increase vineyard-workers' trunk muscle endurance and flexibility. Despite positive effects on these two known factors associated with higher risk of WMSDs of the low back area, the duration of these APA programs were relatively short (i.e. 10 weeks) and to our knowledge, no study has investigated the long term effects of such a program on the risk of developing WMSDs in the low back area.

This study was designed to evaluate (1) the effectiveness of two non-consecutive supervised APA program among vineyard-workers and (2) the effects of a 6 months APA cessation between these two APA programs on trunk muscle endurance, flexibility and pain sensitivity over the low back region.

Methods

Forty-four men and women vineyard-workers were invited to participate in this study. Between November 2015 and April 2017, participants followed two non-consecutive worksite supervised APA programs (i.e. APA round 1 and APA round 2). APA round 1 was implemented between November 15 and April 2016 while APA round 2 was implemented between November 2016 and April 2017. Both APA programs were separated by a 6 months period and consisted of 15 minutes of warm-up before the working day and two weekly sessions of strength and flexibility training. Trunk muscle endurance and flexibility and pressure pain thresholds in the lower back were assessed (1) at the beginning and (2) at the end of each APA programs round.

Results

After each APA programs, trunk muscles endurance, flexibility and pressure pain thresholds over the low back region were significantly increased compared with baseline ($P<0.05$). No significant changes were observed between the end of APA round 1 and beginning of APA round 2. A significant decrease in pain sensitivity was observed between the beginning of APA round 1 and beginning of APA round 2 ($P<0.05$).

Discussion

The implementation of two non-consecutive worksite supervised APA program was found effective in increasing trunk muscle endurance and flexibility and pressure pain thresholds in the lower back. The first APA program was effective as it enabled to maintain trunk muscle endurance, flexibility and pain sensitivity over the six months following the APA round 1. This longitudinal study showed that worksite supervised APA programs can be used to improve and maintain functional capacity and decrease pain sensitivity resulting in diminished risk of WMSDs in the low back region.

OCCUPATIONAL COGNITIVE LOAD PREDICTS MAINTENACE OF ENDURANCE PERFORMANCE WITH MENTAL FATIGUE

MARTIN, K., KEEGAN, R., THOMPSON, K.G., RATTRAY, B.

UNIVERSITY OF CANBERRA

Introduction

Mental fatigue has consistently been shown to impair endurance performance including both time to exhaustion tasks and self-paced time trials (Van Cutsem et al., 2017). A recent study however, reported that when compared to recreational endurance athletes, professional endurance athletes performed better on a mentally fatiguing task of inhibitory control, as well as an endurance task following prolonged mental exertion (Martin et al., 2016). The aim of the study was to determine whether certain lifestyle behaviors, which require a degree of self-regulation, are associated with (a) inhibitory control and (b) resistance to mental fatigue.

Methods

Twenty-four participants completed the randomized, crossover design study. On separate occasions participants completed 90 min of either an incongruent Stroop task or a passive control task (watching a documentary). As a marker of endurance performance, participants then completed a cycling time to exhaustion task at 80% of individual peak power output. Occupational cognitive load and physical training load were quantified for each participant, as a measure of self-regulatory behaviour. Cardiorespiratory fitness, assessed as maximal oxygen consumption, was also determined for each participant.

Results

Occupational cognitive load, physical training load, cardiorespiratory fitness and time to exhaustion during the control condition were predictive of the change in time to exhaustion between the mental exertion and control interventions ($p=0.029$, adj. $R2=0.338$).

Discussion

Higher occupational cognitive load and physical training load were associated with better maintenance of endurance performance when mentally fatigued. Higher cardiorespiratory fitness was associated with poorer endurance performance when mentally fatigued. These findings are promising as they suggest that participation in both cognitive and physical exertion may improve tolerance to mental fatigue.

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Contact

Kristy.martin@canberra.edu.au

Invited symposia

IS-SH01 Leveraging Sport events for Sport Participation and Development

LEVERAGING SPORT PARTICIPATION FROM MEGA-SPORT EVENTS: TRANSLATING POSSIBILITIES INTO POLICIES

WEED, M.

CANTERBURY CHRIST CHURCH UNIVERSITY

Evidence to either confirm or refute the possibility that mega sport events such as the Olympic and Paralympic Games can lead to increases in sport participation is mixed. While there is a lack of evidence that any previous sport mega event has led to increases in sport participation at a population level, this appears to be a failure of delivery rather than possibility.
This presentation will present evidence to show that, if properly leveraged and supported by appropriate evidence based investments and policy, mega sport events have the potential to get those who already participate in sport to participate more often and get those who have participated in the past to participate again. However, evidence will also be presented to show that: firstly, mega sport events do not have an inherent effect on sport participation; secondly, seeking to engage those that do not participate in sport, and never have done, through elite sport, sports people and sport events may actually discourage participation.
In conclusion, the specific case of London 2012 will be explored as an example of how not to deliver a sport participation legacy from a mega sport event, and the ways in which future mega sport event hosts can avoid London 2012's policy failures, and thus successfully deliver population level sport participation legacies, will be identified and discussed.

SPORT EVENTS AND SPORT PARTICIPATION: QUEST FOR A RESEARCH AGENDA

TAKS, M.

UNIVERSITY OF OTTAWA, CANADA

Sport is at the core of sport events. Therefore, it is not unreasonable to expect that sport participation could be a major outcome of hosting sport events. In addition, reducing physical inactivity is a desired outcome of investment that resonates with policy makers worldwide. The question is whether sport events can deliver this so called "trickle down", "inspiration" or "demonstration effect" (e.g., Misener et al., 2015)?
To date, research has not been able to demonstrate that sport events stimulate new participation in sport. If an effect is apparent, it are those who are already (or have been) involved in sport who may participate a little more (e.g., Weed et al., 2015). Most event research to date has focused on planned and tangible legacies of mega-events (both positive and negative).
However, there is a shift in focus into three directions: (1) from tangible to intangible impacts (e.g., Preuss, 2007); (2) from large to small and medium sized events (e.g., Taks, 2013); and, (3) from impacts to leverage (e.g., Chalip, 2014). The current contribution will use these three trends as a guideline to develop a future research agenda in order to enhance our understanding how sport events can be used, and strategically planned to enhance sport participation and development.

THE INSPIRATIONAL EFFECT OF ATTENDING SPORT EVENTS ON SPORT PARTICIPATION IN A METROPOLITAN SETTING: EVIDENCE FROM FIFA WOMEN'S WORLD CUP 2011 IN THE RHINE-RUHR AREA

KURSCHEIDT, M.

UNIVERSITY OF BAYREUTH

Introduction
Many major sport events have been investigated in diverse respects on their socioeconomic impacts. But it was only recently that the "inspirational effect" (Ramchandani & Coleman, 2012) of attending sport events on sport participation has become a topic of interest in the literature. Boardley (2013) theoretically discussed the potential of London 2012 to cause a rise in sport participation whereas Mahtani et al. (2013) reviewed relevant literature in that context. Frawley and Cush (2011) analysed the participation legacy of the Rugby World Cup 2003 in Australia along descriptive indicators over time and experts' interviews. Ramchandani and Coleman (2012) interviewed 2,312 visitors of elite sport competitions in the UK. The present paper builds upon this study for the case of the 2011 FIFA Women's World Cup (WWC) in Germany.
Methods
The data analysis focuses on the intention to participate in sports (ITP), i.e., in playing (more) (women's) football, measured in a 5-point scale. The questionnaire covered item batteries on sports behaviour, attitudes and sociodemographics. Local clusters in the surroundings of the stadia and on the "Fanfests" (fan sites with large screens) were randomly interviewed (N=4,872 from 14 clusters with N=348 on average) at the World Cup cities of Bochum (N=2,187 with N=305 from fan sites) and Leverkusen (N=2,685 with N=458 from fan sites). Thus, the study is placed in the metropolitan setting of the Rhine-Ruhr Area, the largest urban agglomeration in Germany.
Results
Ordered probit regressions on the ITP show that the inspirational impact of attending the WWC is essentially a "reviving effect". The habit to play or watch (women's) football has to be given and will be leveraged by the exposure to the event. The observation also holds for males regarding men's football.
Discussion
Thus, such an event indeed has an inspirational effect on a variety of spectator groups. However, accompanying leveraging policies are necessary.
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Oral presentations

OP-SH08 Performance analysis

SEARCHING FOR THE APPLIED PERFORMANCE ANALYST

MARTIN, D.1,2, O'DONOGHUE, P.G.3, GUERIN, S.2, MCGRATH, D.2
1:ITB (IRELAND) 2:UCD (IRELAND) 3:CARDIFF MET (WALES)

Introduction
Applied performance analysts (APAs) are widely accepted as an integral part of high performance sports science support teams. Their roles generally involve the systematic collection and analysis of performance data and facilitation of its feedback to coaches and athletes. However the role lacks definition or an accepted set of competencies on which to base the training and professional development of practitioners (Carling et al., 2014). The aim of this scoping review is to map the existing literature pertaining to the role of an APA. Here we report the nature of the research undertaken, the sports involved, the continent of origin and the terminology used to describe the practitioner.
Methods
Electronic databases; SPORTDiscus, PubMed, Web of Science, were selected and searched using keyword combinations: Sport; Performance /Video /Match /Notational /Time-Motion Analysis; Feedback /Coach* /Analyst /Video /Applied Practice. 4332 results were screened for duplicates and 2158 were title screened by the first researcher. A random sample of 100 excluded results were title screened by the second researcher. The inclusion criteria were; 1) Description of an applied PA intervention involving an APA; 2) Interview/survey of coaches or athletes about their interaction with an APA; 3) Interview/survey of APAs about their applied practice; 4) Reflections of coaches or APAs about applied practice; 5) Significant discussion of the role of an APA; 6) Published between 2001-2016, in English and peer-reviewed. Both researchers screened 372 abstracts using Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia). 84 abstracts were selected for full text review from which 37 met the inclusion criteria.
Results
The majority of the 37 papers were European (75.7%), with smaller numbers from North America (10.8%), Australia (8.1%) and Asia (5.4%). 9 studies focused on applied practice case studies; 8 case studies developed new methodologies and technologies; 5 review papers, 3 commentary pieces, 3 interview based investigations into feedback and 9 investigations of coaches', athletes' and/or analysts' perceptions of PA. Soccer was the main sport, featuring in 32% of articles. The term 'performance analyst' was used in 51% of papers.
Discussions
The identification of just 37 papers examining the role of an APA highlights a stark chasm that exists between applied practice and academic research. The Euro-centric nature of the research and lack of consensus on terminology suggests that there may be some distance to go in achieving a global standardisation of language and process around the analysis of sports performance.
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Contact
denise.martin@ucdconnect.ie

ANTICIPATING THE INTENTIONS OF OTHERS IN SOCCER: THE IMPACT OF PROBABILISTIC INFORMATION

GREDIN, V.
BRUNEL UNIVERSITY

Introduction
Successful anticipation in sport is underpinned by the ability to integrate sensory information (e.g., opponent's kinematics) with contextual information (e.g., opponent's action preferences). However, little is known about the impact of contextual information on anticipatory performance and the underlying processes employed. We examined the effects of providing probabilistic information on skilled and less skilled soccer players' anticipation performance and their allocation of attention.
Methods
Sixteen skilled (age = 20 ± 2 yrs [M ± SD]; playing experience = 11 ± 2 yrs) and 15 less skilled (age = 21 ± 3 yrs; playing experience = 2 ± 2 yrs) male soccer players viewed video sequences from a first-person perspective. The trials simulated a 2-vs-2 counterattacking situation in soccer from a defender's perspective. Six blocks of eight trials were viewed under two informational conditions – one in which the relative probabilities of the ball carrier's final action (dribble vs. pass) were explicitly announced and one in which no probabilistic information was provided. The participants' response times and accuracy scores with regard to the direction of the final action (right or left) were recorded, as was their visual dwell time on pre-identified areas of interest.
Results
When the final action was consistent with the more likely action, probabilistic information enhanced both skilled (d = 0.36 ± 0.39 [90% CL]) and less skilled (d = 0.68 ± 0.56) players' anticipation efficiency (response time/proportion inaccurate responses). During incongruent trials, the provision of probabilistic information had a detrimental effect on the anticipation efficiency of less skilled (d = 0.26 ± 0.40), but not skilled (d = 0.01 ± 0.30) players. Skilled players allocated their visual attention towards the players off the ball to a greater extent when probabilistic information was available, compared to when it was not (d = 0.45 ± 0.25). This effect was not found in less skilled players (d = 0.01 ± 0.29).
Discussion
Our findings suggest that a priori probabilistic information substantially impacts on how players make judgements and allocate attention during an anticipation task. Furthermore, the magnitudes of these effects alter as a function of skill level. Specifically, probabilistic information seems to have a greater impact on the judgements of less skilled players, whereas for skilled players, the information has greater impact on their allocation of visual attention. This knowledge may be used to inform researchers and practitioners interested in testing and enhancing perceptual-cognitive skills in sport and other domains.

ANALYTIC METHOD FOR EVALUATING PLAYERS' DECISIONS IN TEAM SPORTS

LAMAS, L.1, DREZNER, R.2, OTRANTO, G.3, BARRERA, J.3

1: FEF-UNB (BRASILIA, BRAZIL), 2: EEFE-USP (SAO PAULO, BRAZIL), 3: IME-USP (SAO PAULO, BRAZIL)

Introduction
This work presents a novel approach for evaluating team sports players' decisions in a game. Analysis of individual players in real-world conditions typically consider the result of the player action as a measure for evaluating performance. However, the performance outcome (e.g. goal after a shot) encompasses not only the decision made by the player but also several other elements (e.g. motor execution). The aim of this study was to develop a method for evaluating individual players' decisions, in game situations, based on the success probability of his chosen action instead of considering the result of the action.
Methods
The methodology consisted in formalizing: i) the stochastic process that define a player's decision in a game situation; ii) the inference process of the player strategy based on his decisions in game situations (Lamas et al., 2014). The research framework was applied to the context of soccer goalies. We defined a model of goalie positioning, applying geometric parameters to minimize goal probability. Estimation of goalies' performance was based on the probabilities distribution of a dataset previously created. The dataset was constituted by the decision performance of other goalies, in similar game situations, parameterized by the positioning geometric model. Goalies' entropy was assessed to evaluate their decision consistency. Additionally, we analyzed the impact of the cumulative effect of the goalie's decisions on the goal probability.
Results
Analyzed goalies performed similarly to the lowest probability of goal of the dataset of reference for the distinct classes of game situations defined. Goalies' entropy varied between 0.24 and 0.71 of the maximum possible entropy. Dynamics of goalie positioning previous to a shot indicated that, in goal situations, goalies presented a non-optimal positioning during all the sequence. In save situations, only 28.4% of sequences presented a goalie positioning with more than 0.50 probability of goal.
Discussion
The main contribution of this work was to present an analytical method for evaluating the decision performance of a player not considering the outcome. Model parameters were used to create a dataset of similar situations performed by the players. Then, the dataset probability distribution of successful and unsuccessful results could be used to grade the decisions of any analyzed player. In conclusion, this method overcomes the challenge of analyzing of a player decision not based on the generated outcome but modeling game situations and consulting probabilities of a representative dataset of equivalent actions.
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HOW DO INDIVIDUAL TEAM MEMBERS REGULATE THEIR BEHAVIOR TO ACHIEVE SPATIOTEMPORAL COLLECTIVE BEHAVIOR ?

FEIGEAN, M.1, BOURBOUSSON, J.2, SEILER, R.1

1: UNIVERSITY OF BERN (BERN, SWITZERLAND), 2: UNIVERSITY OF NANTES (NANTES, FRANCE)

Introduction
This study aimed to analyze processes of the emergence of collective behavior patterns. Collective behavior, considered as self-organized, emerges from individual activities that interplay as the activity unfolds. The purpose of the present study was to explore how co-agents actively (co-)regulate their involvement to contribute to the emergence of collective behavior on-site. We did not consider, as often assumed in complex-systems theories, that co-agents couple locally per se, but that the way in which they couple has to be described empirically (Bourbousson & Fortes-Bourbousson, 2016), especially by exploring how they can act by grasping the overall collective behavior they contribute to. To this end, we aimed at describing the variety of 'modes of regulation' achieved by team members during a soccer game. To conduct such an ambition, we adopt an epistemological approach respectful for how human actively regulate their actor/environment coupling (AEC), that was the radically enactive perspective (De Jaegher & Di Paolo, 2007). In this perspective, sense-making is assumed to be central in delineating the dynamics of the AEC, and phenomenological experience of the actor is seriously considered in the study designs.
Methods
One team of expert soccer players (i.e., national level) participated in this study. We video recorded a complete official game using a drone. A sequence of ten minutes was selected, based on which phenomenological data was collected for all of players through individual self-confrontation interviews. The verbal data obtained were transcribed verbatim, from which we reconstructed the visual perception and the associated behavioral adjustment as players can comment it for each instant of the activity under study. Then, a thematic analysis (Braun & Clarke, 2006) helped to identify patterns of meanings within verbalization data, leading to the characterization of various modes of regulation. These modes were then re-positioned within the course of the experience of each teammate, so that co-regulation modes could be identified at each instant of the game.
Results
The results showed the amount of typical patterns of regulating activity carried out by participants, going from a mode of 'local couplings' to one of 'couple through grasping a global picture'. In the collective behavior, the results showed that all the team members were able to share the same mode of regulation at the same time.
Discussion
These results showed that one or several members switched to another mode of regulation, thus helping to avoid the disruption of collective behavior. In other words, the robustness of collective behavior is associated to an individual flexibility. Together, the results provide new opportunities for coaching teams, as it suggests avenues for rethinking how swarming intelligence is conceived in multi-agents systems.

11:30 - 12:45

Plenary sessions

PS-PL02 DEVELOPMENT OF TALENTED PLAYERS TO WORLD CHAMPIONS IN FOOTBALL

DEVELOPING ELITE FOOTBALL PLAYERS: PRACTICE, SPECIFICITY, AND PLASTICITY

WILLIAMS, A.

UNIVERSITY OF UTAH

Mark Williams is a Professor at the College of Health and Life Sciences, Brunel University London in England. His research focus is on the psychological and neural mechanisms which the acquisition and development of perceptual-cognitive and perceptual-motor skills are based upon. He is Editor in Chief for the Journal of Sport Sciences and has written multiple books, articles and abstracts.
In his lecture Williams will look at the factors that determine whether a football player becomes elite or not. Contrary to the common perception, 'talent' cannot be said to be the main determinant in the development of elite football players. Recent research in neuroscience has found that individuals can achieve excellence through many hours of deliberate, purposeful practice. Commitment and continual engagement (7,500 hours of practice before the age of 16 years) may be the most important determinants on the path to excellence. The lecture will highlight some of the key psychological adaptations that result from many hours of practice. A particular focus is set on the development of perceptual-cognitive skills such as anticipation and decision making, and practical implications for talent search and development are highlighted.

SCIENTIFIC SUPPORT FOR ELITE FOOTBALL - LESSONS FROM BRAZIL 2014

MEYER, T.

SAARLAND UNIVERSITY

Tim Meyer is Head of the Institute of Sports and Preventive Medicine at Saarland University, Germany which is one of the FIFA Medical Centres of Excellence. His main research interest is on physiological/medical aspects of football and he functions as a team doctor of die Mannschaft (the German national football team). He is Editor-in-Chief of the Journal "Science and Medicine in Football" and Assistant Editor of the "Journal of Science and Medicine in Sport" as well as "Sports Medicine Open". His department hosts the international PhD programme "Science and Health in Football".
In his lecture Scientific Support for Elite Football – Lessons from Brazil 2014, Meyer will give an insight into the medical and scientific knowledge underlying team support during the FIFA World Cup in Brazil 2014. Generally, the number of scientifically-educated service team members around top-level football teams is increasing. The transfer of their study outcomes to real-life football, however, is limited due to the lacking willingness of teams to regularly participate in scientific studies and a vague reluctance to consequently use evidence-based methods. Therefore, too often routine measurements in uncontrolled settings are published. – Meyer will talk about the results of such studies during the World Cup. Among other topics, some emphasis will be on the prevention of infectious diseases, the management of climate and time zone changes and the recovery measures during practice and matches, e. g. cooling.

13:00 - 14:00

Conventional Print Poster

CP-SH05 Sport management

PROVIDING A MODEL BETWEEN EMPOWERMENT AND PSYCHOLOGICAL CAPITAL AND COMPETITIVE ADVANTAGE OF IRAN SWIMMING FEDERATION

HAMI, M., DAVARPANAH, R., ESHAGHI, H., ZARE, H., AZADI, M.

ISLAMIC AZAD UNIVERSITY, SARI BRANCH

Introduction
The aim of this study is to investigate the relationship between empowerment and psychological capital and the Competitive Advantage of Employees of Swimming Federation of Islamic Republic of Iran and presenting a model.
Methods
The sample population consists of 210 administrative employees of Swimming Federation, as well as coaches and staff of '9 Dey' pools and Azadi Sport Complex and national team coaches and athletes of Leagues of swimming, diving and water polo who formally work with the Federation. To collect information, the questionnaires of empowerment psychological capital and competitive advantage were used. For data analysis, descriptive statistics, frequency, frequency percentage and standard deviation were used and inferential statistics including Pearson, Friedman test, confirmatory factor analysis, LISREL structural equation modeling and SPSS are used.
Results
The results obtained showed that psychological capital and empowerment has a significant relationship with competitive advantage of Swimming Federation Employees and the components of psychological capital (self-efficacy, hope, resiliency and optimism) all have a significant relationship with competitive advantage; But the components of effectiveness and sense of competence have no significant relationship with competitive advantage.
Discussion
Research findings showed that there is a significant relationship between psychological capital and empowering and competitive advantage of Swimming Federation employees. The results were in line with the results of (Johnson, 2015). Research findings showed that b

there is no significant relationship between feeling of being effective and competitive advantage of Swimming Federation employees (Sori.et.al, 2013). According to the survey results, the researcher suggests spreading Positive thinking among employees by managers, meeting the individual needs of employees in the field of employment by managers and creating an emotional bond between the staff and the organization to increase empowerment and presents the structural model.

References

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Contact

mohammadhami@yahoo.com

INTERPRETATION OF UEFA CLUB LICENSING AND FINANCIAL FAIR PLAY REGULATIONS UNDER MERTON FUNCTIONALIST THEORY ANALYSIS PERSPECTIVE AND ENLIGHTENMENT

YU, T.

BEIJING NORMAL UNIVERSITY

Introduction

Positive functions, dysfunctions, manifest functions and latent functions are sociologist Merton's theoretical framework for functional analysis. It combines the logic and strategy of causal and functional analysis, which is an important basis to analyze and evaluate the enforcement effect of sports social institution, policy and law by using sociological structural functionalism.

Methods

This research based on Merton functionalist theory analysis perspective, using the methods of literature review, mathematical statistics, logic analysis and comparative analysis to analyze the functions of UEFA Club Licensing and Financial Fair Play Regulations which approved in 2009 and implemented in 2011. Then expounded the regulations' reference and enlightenment for Chinese professional football that is in the process of comprehensively deepening reform.

Results

The regulations establish benchmarks for clubs' good business and long-term development. The current prosperity of Chinese football need to treat rationally. Clubs' finances and operating conditions should be open and transparent; the category of revenue and cost should be refined carefully.

Discussion

Clubs should pay more attention to give fans humanistic care and social responsibility; youth sector and infrastructure could be the main body of Chinese football's future viability.

DO CITY COLLEGE STUDENTS LIKE DOING PHYSICAL ACTIVITIES MORE THAN RURAL COLLEGE STUDENTS?

LIANGHUI, L., MAOLIN, Y.

CHINA UNIVERSITY OF GEOSCIENCES(WUHAN)

Introduction

There are more public sports resources and better sports atmosphere in Chinese cities than in rural villages. Thus, the youths from the cities can receive more cultivation of sports culture, enjoy more access to sports activities, and they are supposed to be more enthusiastic to do sports exercise. But there is little related academic study to verify this supposition.

Methods

This study has surveyed 2000 college students from 8 Chinese colleges randomly on their attitude to sports activities from September to October in 2014.

Results

The results show that: (1) city college students' sports attitude is lower than the rural college students' sports attitude (68.78% of rural college students pay great attention to sports), and variance analysis shows that the rural college students' sports attitude is significantly higher than that of city college students (p=0.013) and that of county college students (p=0.031). (2) City college students show the lowest interest to sports, only about 41.17% of them having interest to physical activity. The variance analysis shows that the city college students' sports interest is significantly lower than that of the rural college students (p=0.026). (3) 20.39 % of the city college students never take part in physical activities, which is almost twice the number of students from county and rural areas. County and town college students are activists in sports: the ratio of students who do sports often or everyday is higher, and county college students' frequency of doing sports is significantly higher than that of city college students (p=0.036). (4) College students in general don't like to participate in high-intensity sports: especially the rural college students (0.53%) almost never take part in high-intensity sports. Most college students do low intensity sports. Relatively speaking, the ratio of town (41.38%) and county (38.1%) college students who do medium intensity sports is higher, but there is no significant difference among city, county, and town college students. (5) Physical activity duration of college students lies mainly between 0.5 to 1 hours, followed by 1 to 1.5 hours. Not many students do long time sports (more than 2 hours). The ratio of city (19.59 %), rural (18.02 %) and town (15.19 %) college students who do sports less than half an hour is higher. The number of rural college students who do sports between 1 to 2 hours is the highest (41.87%).

Discussion

The county and town college students are sports activists, as they do sports longer in general. Overall, the rural college students' sports attitude and interest are stronger, their participation in sports is greater in strength, and their duration is longer. But their frequency is lower, compared with county and town college students, who are sports activists. In contrast, the city college students' sports preferences are the lowest. This study shows that the college sports should pay more attention to the specific needs of students from different places and the equalization in public sports service should be promoted.

THE EFFECT OF SPORT STAR ADVERTISING ACTIVITY ON THE PSYCHOLOGICAL SENSE OF COMMUNITY

KIM, H.N.1, CHOI, H.S.2
CHOSUN UNIVERSITY

Introduction
This research aims to provide practical data to help sports star advertising companies by building a study module based on precedent study of sports market via mass media, and it defines how sports star advertising effects on the relationship between people's solidarity.
Methods
The goal is that companies which are willing to advertise by professional sports star build up positive images of companies and increase marginal profit of companies in sports market and popularize sports. To verify of a result of the research, target of research was selected as 500 adults, over the age 20, currently residing in Daegu city and Kwangju city in South Korea as of 2012. Convenience sampling was chosen as a sampling method, and questionnaires by 500 people were chosen as valid sampling.
Confidence level shows that a Cronbach's α level is between .884 and .846, and it proves to be appropriate for this study by determining Goodness of fit (R^2) which is approached around 1.0. In addition, multiple regression analysis was used to analyze the result.
Results
Based on such research method, the following results were obtained.
First, a commercial reliability of advertising and a commercial attraction of advertising have psychologically influenced on community solidarity to increase a recognized place and citizen participation.
Discussion
Conclusively, sports star advertising have a significant influence on people , so it causes that people would like to increase community solidarity and they prefer to play sports whenever they want.

A STUDY OF THE RELATIONSHIP BETWEEN TEAM LOYALTY ACCORDING TO THE IMAGE OF SPORT TEAMS

SEO, H.1, KIM, H.N.1, CHOI, H.S.2
CHOSUN UNIVERSITY

Introduction
The purpose of this study was to suggest actual strategy increasing sport competitiveness and added value of sport teams through investigating how professional sport team image factors improving corporate image.
Methods
To complete this purpose, researchers chose the subjects 300 spectators living in Gwangju and Daegu in professional sports games in 2013 with convenience sampling method excluding insufficient respondents. Reliability test of the measuring instrument indicated the Cronbach's α between .942 and .728, which was an adequate value for the objective of the study. Multiple regression analysis was performed for practical data analysis.
Results
Product character of buying factors and purchase circumstance had distinct influence in behavioral loyalty and attitudinal loyalty. As a result of findings, because sport team image affected buying factors and team loyalty, operating sport teams was competitive.
Discussion
To increase team image, the team needed to find and bring up local excellent athletes, show more positive team image through social responsibility activity to the fans.

THE EFFECT OF PERCEIVED CSR ON TEAM IDENTIFICATION AND TEAM LOYALTY IN PROFESSIONAL FOOTBALL IN KOREA

PARK, J.1, KIM, I.2, KERR, S.3
1: GERMAN SPORT UNIVERSITY COLOGNE (COLOGNE, GERMANY), 2: KOREA NATIONAL SPORT UNIVERSITY (SEOUL, SOUTH KOREA), 3: LOUGHBOROUGH UNIVERSITY (LOUGHBOROUGH, UK)

Introduction
Professional sports teams in Korea have been uniquely operated by their parent corporations for PR with the exception of several citizen teams. However, the professional sports are recently considered a promising industry. Consequently, Korean professional sports teams are using social responsibility in society, as Corporate Social Responsibility (CSR) contributes to economic potential, value creation, and the local community (Park & Chang, 2010). CSR is a concept whereby corporations are directly involved in social and environmental issues associated with business operations and stakeholders on a voluntary basis (European Commission, 2001). There has been lots of research on professional baseball teams and CSR (Heo, 2015), but little research examines the relationship between football teams and CSR. Therefore, this study explored how the perceived fit of professional football team's CSR (team and fan perspectives) influences team identification and team loyalty.
Methods
Data were collected from 229 spectators watching professional football match on July 25th, 2015 by using convenient sampling method. After removing 42cases of incomplete or faithless questionnaires, 187 were used for data analysis. For the study, Confirmatory Factor Analysis (CFA) and Structural Equation Model (SEM) were conducted by using AMOS 21.
Results
As a result of CFA, the overall validity and fit could be considered a relatively good model ($x2(df) = 202.598$ (84, $p<.05$); CFI = .924; TLI = .904; RMSEA = .087; SRMA = .07). In addition, the Goodness of Fit of the model was as follows: $x2 = 219.327$, df = 86, $p < .01$, CFI = .914, TLI = .895, SRMR = .088 and RMSEA = .091. As a result of the path coefficients, the perceived fit between the fans and the team's CSR significantly affected team identification (β=.40, t=4.15), but the perceived fit between the team and the team's CSR had no significant effect on team identification (β=.01, t=0.08). Lastly, team identification positively influenced team loyalty (β=.49, t=5.462).
Discussion
The previous research has focused more on the team's point of view, but this study dealt with both the team and fan perspectives. The finding demonstrated that the fan's perspective can be a significant variable to examine the effects of CSR activities in professional sports. It was also worth noting that team identification would be an important attitudinal variable between CSR and team loyalty. Lastly, the finding will help professional sports teams' marketers create and design more effective CSR strategies.

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Contact
j.park@dshs-koeln.de

Conventional Print Poster

CP-PM05 Training and testing in various sports 1

MAPPING THE ECOLOGICAL VALIDITY OF EQUINE GAIT ANALYSIS RESEARCH: A REVIEW OF LITERATURE 1978 – 2015

EGAN, S., BRAMA, P., MCGRATH, D.
UNIVERSITY COLLEGE DUBLIN

Introduction
Progress in wearable technologies has facilitated the transfer of human biomechanical research from laboratory to realistic, performance-specific settings, thus improving the ecological validity of research findings. A scoping review was undertaken to investigate if similar developments are evident in the equine gait analysis literature, and to map the specific opportunities that are opening up in this field.
Methods
Search terms were selected based on the 'PICO' framework [Sampson et al. 2009] and included keywords such as: Equine, Gait, Kinematics, Motion, Analysis and Posture, applied across a number of databases between the years 1978 -2015. Abstracts and full articles were excluded based on pre-determined criteria by two researchers working independently. Research setting was extracted from the remaining 423 articles.
Results
Studies were assigned to the following research settings: Laboratory (49.2%), Other (realistic environment/competition) (30%), Both (combination of laboratory & field based settings) (1.4%), Unspecified tracks of length 30±23.5 metres (9.2%), Not Outlined (6.1%) & Not applicable (4%). The 'Laboratory' category was further broken down as follows: treadmill (27.2%), Force Plate Track (16.1%), unspecified lab (5.2%) and water treadmill (0.7%). 'Other' was further divided into Realistic Environment (26.9%) and Competition (3.1%).
Discussion
Almost half of the studies included were conducted in non-natural or laboratory conditions. Findings from gait analysis generated in such settings may not be generalisable to natural settings. For example, treadmill locomotion in both human [Riley et al. 2007] and equine [Sloet et al. 1999] populations is not always a true representation of over ground, natural locomotion. Given that 6.1% of studies did not specify details of research setting, it is recommended that this should be clearly reported in future to provide the reader with an appropriate context. The primary data collection method in research settings outside of a laboratory was camera-based optical motion capture in the 'Realistic Environment' category. 'Realistic' should perhaps be interpreted with caution however as much of these gait data were collected on short outdoor tracks in clinical settings. The current trend of wearable sensor use for movement analysis in humans is beginning to emerge in equine gait analysis, particularly in the past 4 years, enabling data capture in natural settings. This may ultimately lead to an increase in ecologically valid data being collected from competition settings, which is greatly underrepresented in the literature to date.
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EQUESTRIAN BALANCE

DELEMARRE, S., NIEMEIJER, V., KLEUSKENS, M.
ELKERLIEKZIEKENHUIS

Introduction
Unlike in other sports, the effectiveness of core stability training for the prevention of sport-related injuries has never been investigated in equestrian sports. In horse riding, balance is important for both rider and horse. In this study we investigated the effect of stability training in adult equestrians. It is hypothesized that training core stability will have a positive effect on the rider's balance. The Star Excursion Balance Test (SEBT) was used as a general outcome measure to evaluate the effect of stability training. Since a sport-specific test in horse ridering is lacking, we sought for a functional outcome measure. For this purpose the time riders were able to maintain the half-seat horse riding position was measured, since half seat is considered one of the more difficult forms of riding, requiring a stable position of the equestrian.
Methods
Twenty recreational horse riders from two riding schools in Southeast Brabant, The Netherlands participated in this study: 8 in the intervention group; 12 in the control group. The SEBT is a common used, validated stability test, which can be useful to verify the effect of the intervention, whereas the time half-seat could be maintained in canter was used as a sport-specific test. After establishing a baseline for both groups (t=0), the intervention group participated in a weekly core stability training program for four weeks. The training program mainly consisted of lumbar static and dynamic core stability exercises. After 6 weeks measurements were repeated (t=1). Baseline characteristics were compared using the Mann-Whitney test. To compare the results at t=0 and t=1 the Wilcoxon signed rank test was used. To investigate the relationship between the two outcome measures Spearman's correlation coefficient was used.
Results
Participants in the control group were more experienced (years of riding: 16.1±6.1 years versus 8.3±4.2 years in the intervention group) and performed better at t=0 for both SEBT (p=0.054) and half seat (p=0.030).

In the control group, no difference was found between t=0 and t=1 for both SEBT (77.9± 5.1 % versus 77.5±5.6 %) and half-seat (63.7±41.8 sec versus 64.2±41.1 sec), whereas in the intervention group a significant improvement was found in both outcome measures (SEBT: 68.9±9.5 % versus 77.4±5.6 % [p=0.005] - half seat: 24.7±23.1 versus 47.6±33.2 sec [p<0.001]).
Correlation coefficients between SEBT and half seat were 0.63 (p=0.003) at t=0 and 0.55 (p=0.012) at t=1.
Discussion
Stability training has a positive effect on the stability of horse riders, at least in less experienced riders. Half seat seems a promising tool for to evaluate stability (training) in equestrians, although it might be less useful in more experienced riders. To draw more definite conclusions on both the effect of stability training in horse riding and the usefulness of half-seat as sport specific outcome measure more research is needed.

ACUTE EFFECTS OF STATIC VS. BALLISTIC STRETCHING ON H/Q RATIO BETWEEN BALLET DANCERS AND RESISTANCE TRAINED WOMEN.

LIMA, C.D., BROWN, L.E., RUAS, C.V., BEHM, D.G.
MEMORIAL UNIVERSITY OF NEWFOUNDLAND

Introduction
Stretching is a technique that elongates the muscle and soft tissues for a short period of time, and is used to enhance joint flexibility. Stretching has also been shown to acutely decrease muscle strength, therefore increasing lower-extremity injury risk. However, these negative effects may depend on the population and mode of stretching. While ballet dancers aim to have high levels of flexibility and begin training at a very young age, resistance trained women's main goal is to achieve high levels of strength. Also, static stretching seems to decrease the Hamstrings/Quadriceps (H/Q) ratio, while ballistic stretching may not result in similar outcomes. Therefore, these negative effects from stretching may differ between both populations and type of stretching. The purpose of the study was to compare the acute effects of static vs. ballistic stretching on concentric H/Q ratio between ballet dancers and resistance trained women.
Methods
Fifteen resistance trained women (23.8 ± 1.80 yrs, 67.47 ± 7.77 kg, 168.30 ± 5.53 cm) and 12 ballet dancers (22.8 ± 3.04 yrs, 58.67 ± 5.65 kg, 168.00 ± 7.69 cm) performed 3 days of testing. The first day was control (no stretching) while the other two days were static or ballistic stretching in a counterbalanced order. For each day after the dynamic warm up, they performed six different stretching exercises, three focusing on quadriceps and three on hamstrings in a counterbalanced order. Each stretching exercise consisted of three sets of 30 second holds with 15 seconds rest. Immediately after stretching, they performed five maximal concentric knee extension/flexion repetitions at 60°/s on a Biodex isokinetic dynamometer. The H/Q ratio was calculated as the quotient of hamstrings peak torque over quadriceps peak torque.
Results
Both groups demonstrated a significant decrease in H/Q ratio after static (0.59 ± 0.07) and ballistic stretching conditions (0.58 ± 0.06) when compared to control (0.64 ± 0.07). However, neither group demonstrated any difference between static and ballistic stretching.
Discussion
These findings suggest that both ballet dancers and resistance trained women decrease H/Q ratio similarly after ballistic and static stretching. Independent of training background, stretching can negatively impact H/Q ratio, leading to increased muscle imbalance.

PREVALENCE OF CHEERLEADING INJURY IN KOREAN CLUB SPORTS YOUNG CHEERLEADERS

YUN, S.1, HWANG, E.1, PARK, C.H.3, HAN, Y.B.3, LEE, D.T.2
KOOKMIN UNIV.

Introduction
Cheerleading is a fast growing school based club sport in Korea. It involves high degree difficulty of skills based on gymnastics such as partner stunts, pyramid, cradle, transition In competitive spirit squads, cheerleading demands physical fitness and partnerships and causes high risk of injuries(Shields, & Smith, 2006, 2011).However, no informative studies reporting injury prevalence of Korean teenage cheerleaders exist. This study describes the epidemiology of middle and high school cheerleading injuries in Korea.
Methods
Data were collected during the 2016 Korea National Sport Cheerleading Competition. Approximately 1,500 registered cheerleaders participated and 769 teenage cheerleaders voluntarily responded to a questionnaire.The questionnaire asked demographic information, cheerleading experience, and practice conditions. Their injury prevalence was surveyed for injury sites, types, causes, and treatment, and the period of recovery and return.
Results
A total of 435 teenagers (57%) reported an experience of injuries.Most frequent injuries occurred at wrist, ankle, knee, shoulder, and waist, and the most of injuries were the muscular pain and contusion.
They were injured when they performed Elevator; Credle; Credle and Basket toss; and Credle and Pyramid, for those who had experienced <0.5; 0.5-1; 1-2; and 203 yrs, respectively. These techniques involved in bodily movements of going up and down. About 56%of injury was self-treated at home or not treated at all, and 60% of injury was either self-treated or not intervened. They returned to cheerleading practice within 2 weeks even though they still suffered with injuries. More than 50% of injured cheerleaders returned without complete recovery. Only 32% of cheerleaders practiced on a formal mattress. Those who practiced conditioning and strength training 3 times a week in a regular base were only 140 (32%).
Discussion
No previous studies reported cheerleading injury rates of Korean cheerleaders, and this is the first report, in particular for the youth. Many cheerleading injuries reported are preventable. And education program for the young athletes and coaches may be necessary. Guidelines and Measures for securing and improving safety for these youth cheerleaders are urgently called. Continuous surveillance and research also should be implemented.
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Contact
[ysmysm7@naver.com]

POTENTIAL MUSCLE IMBALANCES IN CLUB LEVEL FENCERS

BOTTOMS, L., SINCLAIR, J.K.

UNIVERSITY OF HERTFORDSHIRE AND UNIVERSITY OF CENTRAL LANCASHIRE

Introduction
Previous research has illustrated fencers to have a greater cross-sectional area of the dominant forearm, arm and thigh (Margonato et al., 1994), highlighting that muscle imbalances can be a problem in fencing. The aim of the current study was to examine ipsilateral and bilateral muscle imbalances in knee, shoulder and hip flexion and extension in club level fencers, which have all previously been established as the main contributors to the maximum velocity of the weapon during the lunge movement (Bottoms, Greenhalgh and Sinclair, 2013).
Methods
Twelve club level fencers (age 28±4yrs; height 165±18cm; weight 75±12kg) were recruited. They each undertook three different movements on an isokinetic dynamometer (Biodex, System 2). The movements included knee flexion and extension, shoulder flexion and extension and hip flexion and extension. All were performed at 60°/s on both dominant and non-dominant sides. Peak torques during concentric contraction of both the opposing muscle groups were determined and from this a muscle group ratio was calculated to determine ipsilateral imbalances. In addition, bilateral ratio was determined using peak torque values.
Results
The mean (±SD) peak torque at the non-dominant quadriceps during knee flexion was 147.4 ±52.6 Nm compared to dominant which was 155.8 ±54.9 Nm, this gave a bilateral ratio of 0.93 ±0.18. Only two of the twelve fencers exhibited distinct bilateral imbalances between non dominant and dominant sides. The mean hamstring peak torque was 80.0 ±23.1 Nm for non-dominant, compared to 87.3 ±26.7 Nm for dominant. The mean hamstring: quadriceps for non-dominant was 0.56 ±0.10, compared to 0.57 ±0.12 for dominant with nine fencers for both sides demonstrating an imbalance. No bilateral imbalances were found for either flexion at the shoulder or hip (1.01 ±0.17 and 0.99 ±0.11 ratios respectively). Neither were there bilateral imbalances for extension at the shoulder and hip (1.09 ±0.29, 0.99 ±0.39 ratios respectively).
Discussion
In conclusion, club level fencers do not appear to have bilateral imbalances at the shoulder, hip and knee joints, which disagrees with previous research (Tsoiakis et al., 2006). The results could be due to increased strength and conditioning knowledge by both the coach and fencers producing a more balanced training routine.
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Contact
l.bottoms@herts.ac.uk

TREE TACTICS IN FENCING: ELITE EPEE MEN'S

IGLESIAS, X., TARRAGÓ, R.

INEFC-BARCELONA, UNIVERSITAT DE BARCELONA

Introduction
Many are the fencing masters to structure their training lessons according to tactical thinking processes designed by the Hungarian master Szabó (1977). The aim of this study is to devise a tree structure of tactical actions and their effectiveness in elite epee men's.
Methods
This was done using an observational methodology based on an open and systematic process of non-participant observation with a nomothetic, punctual, multidimensional design (Anguera et al., 2011). The tactic structure was drawn from the analysis of the fencing phrases following Szabó's tactical levels model. 29 male epee combats were recorded during two World Championships (2013-14). The observation instrument used was an adaptation of the ESGRIMOBS (Tarragó et al., 2015). The actions were recorded and coded using LINCE v.1.1 (Gabin et al., 2012) software. This analysis is focused on the actions and reactions of each fencer and his opponent during each exchange.
Results
Analysis of 39 fencing phrases which frequency was equal or greater than 2 (n = 1,301). The largest number of actions end at tactical level II (n = 746), III (n = 214) and IV (n = 307). Up to 40% of the actions ended in touch. Table 1 shows the tree tactics in elite fencing. The distribution of tactical interaction and the efficacy values can be assessed in relation to the fencer who initiates action (fencer 'A') on its opponent (fencer 'B'). The 17.1% of the actions end up favoring fencer 'A', whilst 15.1% favour the opponent (fencer 'B') and 8% end in a double touch. The most common action in elite male epee (n = 356) is level II (offensive 'A' and counteroffensive 'B').
Discussion
Decision-making processes determine the interaction between opponents. These processes are conditioned by the coach's fencing lessons. This tree allows the identification of the most favorable situations for the fencer who initiates the offense ('A') or his opponent's ('B') at various levels of tactical thinking (I to VI). Tree analysis of tactics presented in this study can boost the optimization of training decisional factors in fencing. As main contribution of this study (Tarragó, 2017), we present an original structure for the distribution and effectiveness assessment of tactical actions in fencing.
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THE USE OF ANTHROPOMETRIC FACTORS IN TALENT ION IN SWIMMING

ALTMANN, K.
INSTITUTE OF APPLIED TRAINING SCIENCE (IAT)

Introduction
Anthropometric parameters have a significant influence on swimming performance (e.g. Morais et al, 2013). They are therefore crucial for talent selection. The German swimming Federation is using current body height (CBH) and the Broca-Index (BI; relation between body height and weight) in their talent selection process. However, those parameters might be imprecise due to the different rate of maturation and time of maturity (Malina et al, 2004). Aim of the present study was to analyse development stability by using different anthropometric parameters that shall result in more valid predictions for future talents.
Methods
Anthropometric parameters (i.a. body height, weight, arm-span, shoulder and hip wide, sitting height) of 1982 athletes (♂49.9%; age 10 to 18) from different types of sports and with variable number of longitudinal data were analysed. Bivariate longitudinal correlation analyses for all anthropometric parameters between different time points were calculated. The calculation of the predicted adult body heights (PABH) were performed using the method reported by Sherar et al (2005).
Results
The Ape index (AI; relation between arm-span and body height) at the age of 13 and at the age of 18 are highly correlated (♀ $r(32)=.82,p<.01$;♂ $r(47)=.83,p<.01$). While the PABH shows a higher correlation ($r(32)=.80,p<.01$) than the CBH for girls between the age of 13 and the age of 18 ($r(37)=.69,p<.01$), the correlations are nearly the same for boys. The BI showed the lowest correlation for all analysed anthropometric factors between the age of 13 and 18 (♀ $r(37)=.69,p<.01$;♂ $r(49)=.59,p<.01$). The correlations between the PABH in adolescence and the height at the age of 18 are higher than the correlations between the CBH and the height at the age of 18 with only one exception.
Discussion
In order to guarantee an effective talent selection process in swimming, it is mandatory to use parameters showing high stability during the development from childhood to adulthood. The analyses show that data acquired using the BI and CBH varied through the athletes' biological development. Furthermore, the data suggest a higher stability of the AI and the PABH during the athletes maturing process than the current anthropometric used factors. In conclusion, it is recommended to introduce those factors in recent talent selection processes. In addition, other factors with a high influence on performance (e.g. foot length-body height ratio) should be investigated regarding to their developmental stability.
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EFFECT OF BLOCKED VISION ON THE REPRODUCIBILITY OF BALLET LEG POSITIONS IN ELITE JAPANESE SYNCHRONIZED SWIMMERS

KOMORI, Y., OHNISHI, H., KAMIYOSHI, M., KAWAI, Y., SHIMURA, Y., HOSHINO, S.
OSAKA INTERNATIONAL UNIVERSITY

Introduction
Synchronized swimming is a competitive sport, which is judged based on synchrony between music and the movements of each swimmer. A synchronized swimming competition includes figure session and routine sessions. All 200 specified figures are constituted from movements of the leg, such as hip extension-flexion movements. In particular, the ballet leg positions (from a back layout position to raising a leg and keeping the hip flexion angle at 90 degree) account for 40% of the figures. Therefore, precise control of the hip flexion angle is important for synchronized swimmers.
Visual information is an important factor in the performance of multiple movements. Therefore, the purpose of this study was to examine the effect of blocking a swimmer's vision on the reproducibility of ballet leg positions among elite synchronized swimmers.
Methods
Twenty-four elite female synchronized swimmers and 11 female water polo players participated in this study. The participants were divided into the following 2 groups: synchronized swimmer group (SS, n = 24) and water polo group (WP, n = 11). All participants performed the ballet leg positions under normal and blocked visual conditions, both in water and on dry land. The repositioning error (RE) of the hip flexion angle was evaluated using an image analyzing system with high-speed video cameras.
Results
The RE for the ballet leg position of the SS group was 5.2° ± 5.0° and 5.0° ± 4.4° in water, respectively, and 4.5° ± 4.1° and 3.7° ± 3.8° on dry land under blocked and normal visual conditions, respectively. In the SS group, no difference in RE for achieving ballet leg positions in water and on dry land was found between the blocked and normal visual conditions. The WP group showed differences in RE as compared with that noted in the SS group.
Discussion
These findings showed that the precise reproducibility of ballet leg positions had no correlation with vision either in water or on dry land. Therefore, elite synchronized swimmers are able to achieve high reproducibility of ballet leg positions without reliance on visual cues.
Contact
komori@oiu.jp

PROGRESSION AND AGE AT PEAK PERFORMANCE OF ELITE MALE TRIPLE JUMPERS

NIESSEN, M., HARTMANN, U.
UNIVERSITY LEIPZIG - FACULTY OF SPORT SCIENCE

Introduction
The triple jump (TJ) is a motion technically challenging and physically demanding discipline in athletics. It is debated whether success at World Youth (WYC) & Junior Championships (WJC) are a prerequisite for achievements as senior athlete in World Championships (WC) & Olympic Games (OG). The performance evolution in elite male TJ appears to reach a state of stagnation, and the junior (1985) & senior

(1995) world records are untouched. Aim is to investigate the competitive success, the development and improvement of performance in elite male junior to senior triple jumpers.
Methods
The data were extracted from renowned databases (www.laaf.org; www.tilastopaja.net) through 12/2016. Competition results of finalists (1st-8th place) at WYC (1999-2015; n=72), WJC (1986-2016; n=125), WC (1983-2015; n=70) and OG (1984-2016; n=53) as well as profiles of legally achieved outdoor season bests (SB) of all-time best TJs ≥17.5m (G1; n=62 athletes) and of selected medallists of above mentioned champs with personal bests (PB) between 17-17.49m (G2; n=30) and <17m (G3; n=27) were empirically analysed. Comparisons of selected age groups, of finished (CFI) and ongoing careers (CON) were made. Analytical statistic was applied.
Results
The above mentioned champ-final results did not alter significantly within the last 33yrs, except for WYC. They showed a sig. short-term performance increase in 2005 & 2013. A total of 34 senior G1 won at least 66 medals at WC & OG; 11 of them were elite juniors (13 medals). The CFI of G1 were high sig. longer than for G2 & G3 ($F(2,88)=10.7$; $p \leq 0.001$); showed a negative quadratic trend. Age at peak competitive performance (PCP) of CFI was 25.3±2.8yrs (G1), 23.2±2.6yrs (G2), and 19.6±2.7yrs (G3) ($F(2,88)=30.1$; $p \leq 0.001$), but not sig. different to CON. G1 attained the PB distance (increase from first world-listed performance: +1.7±0.8m) within 10.4±5.0yrs, high sig. later than for G3 (improvement: +1.0±0.9m) ($T(86)=4.6$; $p \leq 0.001$). The attrition rate of 11 WYC & 7 WJC medallists was 24%. They reached a PB of 16.5±0.5m within 0-5yrs after medal success and ended careers before entering age group under 23yrs after 4.2±2.2yrs.
Discussion
The probability of the transition to senior performances was greater if the junior athlete won a medal. WYC & WJC could be a springboard for entry into elite TJ. But also >80% of G1 were late entrants or sub-elite juniors. On the other hand an early performance stagnation or increased attrition rate could be possibly caused by e.g. injuries, deficits in physical fitness, performance, training (specialisation, load, regeneration), or mental skills. Further research is needed to guide athlete's development pathway persistently and identify qualitative factors to strengthen the process for a carefully long-term evolution.

SEX-RELATED DIFFERENCES IN GROWTH AND PATTERNS OF DEVELOPMENT OF THIGH MUSCLE THICKNESS, ANAEROBIC POWER, AND SKATING PERFORMANCE IN JUNIOR SPEED SKATERS

KUMAGAWA, D., TSUNODA, N.
JAPAN INSTITUTE OF SPORTS SCIENCES

Introduction
Lean body mass and power generation capacity are improved by training in speed skaters (Nemoto et al. 1990, de Koning et al. 1991). Further, these functional characteristics of muscle are closely related to skating performance. However, male and female growth patterns in adolescence are different. Therefore, sex-related differences in the mass and anaerobic power generation capacity of the lower limb muscles are expected in speed skaters during puberty. This study investigated the effects of sex-related difference in development on rates of change in thigh muscle thickness, power generation capacity, and skating performance in Japanese junior speed skaters.
Methods
Subjects were 472 male and 350 female speed skaters aged 9–18 years in whom anterior thigh thickness (MTTa) and lateral thigh thickness (MTTl) were measured on B-mode ultrasound. Maximal anaerobic power (MAnP) was measured using a bicycle ergometer. Mean skating velocity in the 500-m event (SV500), calculated from recent individual best times, was used as a measure of skating performance. Mean values for these parameters were calculated by age, and rates of change were calculated by differentiating these values with respect to time.
Results
MTTa and MTTl were greater in female skaters than in male skaters aged 15–18 years. MAnP and MAnP normalized by body mass were significantly higher in male skaters than in female skaters aged 13–18 years. Moreover, SV500 was higher in the male skaters than in the female skaters aged 10 years and 12–18 years. Peak height velocities occurred at 12.0 years of age in male skaters and 9.8 years in female skaters. The highest rate of increase in thigh muscle thickness occurred at 13.3–13.6 years in the male skaters and at 10.9–11.8 years in the female skaters. In the male skaters, the highest rates of change in MAnP and SV500 occurred at 13.0 years and 12.5 years, respectively, almost coinciding with the highest rate of growth in muscle thickness and body height. However, in the female skaters, the highest rate of change in SV500 (9.4 years) occurred before the highest rate of increase in MAnP (11.8 years) and muscle thickness (10.9–11.8 yers).
Discussion
In the male skaters, the highest rate of development occurred in order of body height, skating performance, power generation capacity, and muscle thickness. Developmental patterns in these parameters were similar in the male skaters, whereas rapid development of skating performance occurred before the highest rate of increase in power generation capacity and muscle thickness in the female skaters.
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EFFECT OF BLOOD LACTATE AND ACTIVE OXYGEN ON HOLDER TRAINING OF ELITE SPORT CLIMBING ATHLETES

SON, Y.H., OH, J.R., SEO, Y.H.
CHOSUN UNIVERSITY

Introduction
Sports climbing is divided into difficulty, speed, dual, and bouldering competition according to climbing game. Most climbers are unable to climb within the time limit and fall off, which is a phenomenon in which the climbers are lacking in a variety of skills and physical strengths, and excess accumulation of lactic acid or free radical in the blood. The purpose of this study is to provide information on the improvement of performance to the athletes and leaders by measured the active oxygen levels in climbers and recognized the importance of blood reactive oxygen.
Methods
Ten elite sports climbing athletes were divided into holder training exercise group (n = 5) and control group (n = 5), which were subjected to general training, that was conducted five times a week for 12 weeks. Subjects measured body composition and reactive oxygen measurements before and after exercise, and compared the effects of exercise between the two groups. Data were processed by two-

way repeated ANOVA and when there was a significant difference, the corresponding sample and the independent sample t-test were performed. All statistical settings were .05.
Results
As a result of this study, blood lactic acid of elite sports climbing athletes was statistically significant and showed a significant difference in Time and Time * Group ($p < .05$). There was a statistically significant difference in serum reactive oxygen species and a significant difference in Time * Group ($p < .05$).
Discussion
For the elite climbers, holder training was shown to be effective in reducing blood lactate and reactive oxygen levels. Luisa(2006) suggested that resistance to lactic acid during climbing and its ability to remove it may be advantageous. Kim, Doo-Hyung, Kim Ki-Jin(2003) reported that blood lactate concentrations and free oxygen levels were lower in people with better climbing abilities. Continuous holder training is an exercise program for elite climbing players to lower the blood lactate concentration and reactive oxygen level and present them to the athletes.
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Contact
31942580@hanmail.net

ISCHAEMIC PRECONDITIONING DOES NOT IMPROVE REPEATED SPRINT ABILITY IN ELITE RUGBY SEVENS PLAYERS.

PATTERSON, S., GISSANE, C., HOWELLS, D., GRIFFIN, P.J.
ST MARYS UNIVERSITY

Introduction
Ischaemic preconditioning (IPC) (brief episodes of ischaemia followed by reperfusion) has been shown to acutely increase peak power output in the early stages of a repeated sprint protocol in recreational trained athletes (Patterson et al. 2015). Whilst this is of interest, the application of IPC in well trained / elite athletes are limited, therefore we investigated the effect of IPC on repeated sprint ability in a group of elite rugby 7's athletes.
Methods
Twelve healthy, national squad, male rugby 7's athletes who regularly play on the World Rugby HSBC Rugby 7's Series volunteered to participate in the study. All participants visited the laboratory on three separate occasions during a pseudo-double-blind, randomised, within-subjects, crossover designed. Following familiarisation, participants visited the laboratory on two occasions where they performed four cycles of 5-minute, bilateral cuff inflation of the proximal thigh at 220 mmHg (IPC) or 20 mmHg (SHAM) followed by 5-minutes of reperfusion. Ninety minutes post cuff application participants performed a repeated sprint protocol consisting of 3 sets of 6 repetitions of 15 + 15 m shuttle sprints (i.e. 30 m total distance with 180◦ turn), with 20-s passive (standing) recovery between repetitions. During both trials, best, worst, total time and fatigue decrement was recorded. Muscle oxygenation of the right vastus lateralis was recorded at rest, throughout the intervention, and during exercise.
Results
There was no difference between IPC and SHAM for fastest or slowest sprint times. When comparing all 18 sprints, there was a small but non-significant interaction effect for IPC on the sprint times ($p = 0.394$, $d = 0.22$), but very large and significant main effect for sprint number ($p = 0.001$, $d = 3.71$), with a trivial and non-significant main effect for condition ($p = 0.856$, $d = 0.12$). In addition, the percentage decrement across the 18 sprints was not significantly different between IPC and SHAM interventions; neither was the total time taken to complete all 18 sprints.
Conclusion
IPC applied 90-minutes prior to a repeated sprint shuttle protocol did not have any effect on elite male rugby 7's sprint performance. Future research should focus on investigating the effect of IPC during simulated games for team sport athletes.
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CP-PM12 Cardiovascular physiology

EFFECTS OF TWO TYPES OF PHYSICAL TRAINING EXERCISE ON VENTRICULAR CARDIOMYOCYTES REMODELING OF HYPERTENSIVE RATS.

DELPECH, N., KRZESIAK, A., SEBILLE, S., COGNARD, C., BOSQUET, L.
UNIVERSITY OF POITIERS

Introduction
Hypertension is an important public-health problem because of its high frequency, and its associated risk of cardiovascular diseases. Exercise training offers a possible non-pharmacological therapy for cardiovascular diseases including hypertension. Studies have shown that aerobic exercise training induces reduction in blood pressure in hypertensive patients, attenuates afterload on the heart which would explain why the training can mitigate cardiac hypertrophy in hypertension. High intensity intermittent exercise (HIIE) training has been shown to have, as much or even more beneficial cardiovascular effect in patients with cardiovascular diseases (including hypertension) than moderate intensity continuous exercise (MICE) training. If studies have been carried out to understand mechanisms responsable for the remodeling of cardiomyocytes after HIIE training in heart failure rats (Wisloff et al, 2002), to our knowledge, this was not explored in SHR.
The aim of this study was to compare the effects of MICE and HIIE training on ventricular cardiomyocytes remodeling in SHR. This work focused on different stages of calcium cycling.
Methods

After eight weeks of treadmill training, maximal running speed (MRS) and mean arterial pressure (MAP) of eight-week-old rats were measured. Thereafter, cardiomyocytes were enzymatically isolated and investigated.
Results
MRS in trained SHR increased to 40 m/min and reduced (from 28 to 25m/min) in untrained SHR. MAP decreased from 145 ± 4 mmHg in untrained SHR to 119 ±3 and 130 ± 3 mmHg in MICE trained and HIIE trained SHR respectively. The space organization regularity of the transverse tubular system increased in trained SHR vs untrained SHR to level between untrained SHR and control ones (Wistar-Kyoto). In trained SHR, calcium spontaneous events analysis revealed a drastic reduction of the release site density and firing frequency which were more marked with HIIE than with MICE training. We also observed an increase in the expression level of SERCA2a and in the phosphorylation degree of PLBser16 after MICE and HIIE training.
Conclusion
Regardless of the type of training, it leads to mitigation of the deleterious hypertensive characteristics of cardiomyocytes.
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Contact :
nathalie.delpech@univ-poitiers.fr

KINETIC OF LEFT VENTRICULAR FUNCTION AND MECHANIC DURING THE TRANSITION FROM REST TO EXERCISE IN TRAINED CYCLISTS.

IZEM, O.

UNIVERSITÉ D'AVIGNON

In endurance-trained subjects, VO2 kinetic during the transition from rest to exercise is faster than in sedentary subjects partly due to a faster cardiac adaptation. However, due to technical limitations, data regarding cardiac adaptation during these transitions are restricted to heart rate (HR), stroke volume (SV) and cardiac output (Q). In this context, we aimed to evaluate the kinetics of left ventricular (LV) systolic and diastolic regional functions using Doppler and 2D-strain echocardiography at the onset of dynamic exercise in 20 highly trained cyclists (22 ± 4,7 yr old ; >10 h per week of training) and 22 age-matched sedentary subjects (22 ± 4,5 yr old). We used an original approach based on 5 similar 4-min constant load exercises performed on a specific semi-supine ergometer to assess 1) VO2 and Q, 2) LV diastolic filling from transmitral Doppler, 3) LV longitudinal strains from an apical 4 chambers view, 4) and 5) LV circumferential strains and rotations from parasternal short axis views at the base and the apex. During each exercise, echocardiographic data were recorded every 15 sec during the first min and then every 30 sec until the end of the test. LV filling pressures were evaluated using the strain imaging diastolic index. Our results indicated that VO2 kinetic was faster in cyclists, associated with faster Q and HR kinetics. SV increased until 60 sec in cyclists whereas it plateaued from 30 sec in sedentary subjects. LV longitudinal and circumferential strains adapted similarly in both groups, whereas kinetics of systolic basal circumferential strain rate were faster and values higher in cyclists. LV filling kinetic was faster and values were higher in cyclists during the first min of exercise. In both groups, LV filling pressure increased during the first 15 sec and remained unchanged thereafter, but with lower values in athletes. However, diastolic circumferential strain rate, an index of LV relaxation, and untwisting rate, one key element of LV filling (that promotes LV intraventricular pressure gradient and suction), increased further in cyclist than in sedentary counterparts during the first min of exercise. Our findings supported that at the beginning of the transition from rest to exercise, adaptation of the diastolic function and its underlying mechanisms was improved in cyclist, enabling a prolonged and higher increased in SV.

EFFECT OF 8 WEEKS TRAINING WITH AND WITHOUT POMEGRANATE ON BOOLD PRESURE AND VO2MAX IN MIDDLE AGE WOMEN

SADEGH EGHBALI F., BIJEH, N., ATTARZADEH HOSSEINI, S.R.

DEPARTMENT OF SPORT SCIENCE, FERDOWSI UNIVERSITY OF MASHHAD, MASHHAD IRAN

Introduction
Metabolic syndrome is a cluster of metabolic and cardiovascular disorders, such as hypertension, central obesity, dyslipidemia and disrupted glucose metabolism that can lead to diabetes type II and cardiovascular diseases. The strategy suggested for treating metabolic syndrome is promoting lifestyle and health. Healthy lifestyle promotion and rich herb supplements with anthocyanin and phenol are recommended for treatment.The purpose of this research was to investigate the effects of 8 weeks of combined training exercise with and without pomegranate concentrate consumption on Blood pressure and VO2max in middle-aged women.
Methods
In this semi-experimental research, 24 inactive middle-aged women afflicted with a metabolic syndrome (mean age: 45±5 years, mean BMI:31±4 kg/m2) were randomly divided into two groups: a combined training (n=12) and a combined training with pomegranate concentrate consumption group (n=12). The combined training was comprised of an aerobic exercise (60-80% intensity of Maximal Heart Rate (HRmax),) and a resistance exercise (weight training with 60-80% intensity of Maximal Heart Rate (HRmax),) and took 8 weeks (3 sessions a week) to complete. The combined training group with pomegranate concentrate, besides the exercises, consumed 50 grams of pomegranate concentrate a day in two meals of 25 grams after lunch and dinner. The testers had a fasting blood test once 24 hours prior to the first training session and once again 48 hours after the last training session. The data were analyzed by SPSS ver20.0 through Shapiro-Wilk test, independent and paired-sample t-tests. Level of significance was set at $p<.05$.
Results and Discussion
It seems that regular physical exercises along with consuming pomegranate concentrate can probably be effective through reducing blood pressure as the key index of controlling cardiovascular diseases. Through improving a number of metabolic syndrome indices it can help to prevent its resultant side effects in middle-aged women.

EFFECTS OF ORAL CONTRACEPTIVES AND PHYSICAL HABITS ON HEMODYNAMICS AND ARTERIAL STIFFNESS IN YOUNG WOMEN

ENEA, C., LAFFETAS, P., PICHON, A., DELPECH, N.
UNIVERSITY OF POITIERS

Introduction
Oral contraceptive (OC) pill has been available for more than 50 years and is currently the most commonly used method of reversible contraception in the western countries. Although OC pill is considered as safe for the vast majority of women, its use is associated with a tiny but significant increase in central and peripheral blood pressure (Yu et al., 2014) and arterial stiffness (Hickson et al., 2011). Conversely, physical activity is known to have benefits on vascular structure and function, suggesting that negative effects of OC pill on hemodynamic parameters could be counterbalanced by regular physical activity. The aim of this study was to determine the combined effect of OC pill use and physical activity on central hemodynamics and arterial stiffness.
Methods
42 young healthy women (22.0 ± 2.1) were recruited and divided into four groups, depending on their hormonal status (OC users (OC+) or non OC users (OC-) for at least 6 months) and their physical habits (active/inactive, determined by the Global Physical Activity Questionnaire). Assessments of central hemodynamics (central blood pressure (cBP), augmentation index (Aix)) and carotid-femoral pulse wave velocity (PVW) were performed after 10 minutes of rest in a supine position, using applanation tonometry. Kruskal-Wallis test and analysis of variance (hormonal status x physical habits) were performed to determine differences between groups.
Results
Women taking the OC pill had higher brachial and central systolic blood pressures compared with nonusers, independently of their physical habits (OC+: 98.6 ± 6.1, OC-: 92.0 ± 2.7 mmHg). No effect of hormonal status was found for Aix and PWV, while lower PWV values were found in active groups compared with inactive (5.6 ± 0.5 vs. 6.2 ± 0.7 ms-1, respectively).
Conclusion
OC pill intake was associated with higher aortic and peripheral blood pressures, but not with increased arterial stiffness. However, arterial stiffness in young active women is lower than in age-matched inactive controls, suggesting that the positive effect of regular physical exercise on cardiovascular system is already visible in the first years of women adulthood.
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Contact
carina.enea@univ-poitiers.fr

THE IMPACT OF TYPE OF SPORT, GENDER AND AGE ON RED BLOOD CELL DEFORMABILITY OF ELITE ATHLETES: A CROSS-SECTIONAL STUDY

TOMSCHI, F., PREDEL HG., BLOCH, W., GRAU, M.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
To deliver oxygen to muscles and organs in the human body red blood cells (RBC) have to deform to pass capillaries of different, mostly smaller, caliber. In high performance sports, aerobic and anaerobic endurance and strength performance depends on oxygen supply in the microcirculation of the working muscle. Thus, the aim of this study was to detect possible differences in RBC deformability of elite athletes performing different type of sports and being of different age and gender.
Methods
182 elite athletes (90 female/92 male) age 11-34 were included in this study. Athletes were subdivided into different age and sport groups. RBC deformability was measured using the laser-assisted optical rotational red cell analyzer. The ratio (ElRatio) of pressure necessary for half-maximum deformability (SS1/2) and maximal deformability was calculated with low values representing high RBC deformability (Baskurt et al. 2013).
Results
Negative correlation was calculated for ElRatio and age. ElRatio was highest in young and lowest in adult individuals. No difference was found in ElRatio between male and female athletes. No significant difference was found between different sport groups, but ElRatio tended to be lowest in endurance dominated sports.
Discussion
RBC deformability is influenced by the age of the athlete, which might be explained by the onset of sex hormones during puberty, known to affect erythropoiesis, since young RBC show a better deformability mailnly due to a better surface-to-volume ratio. Comparable RBC deformability values measured in male and female athletes and no difference between sport types tested might be explained by the fact that high volumes of training in general lead to an intravascular hemolysis of primarily old and rigid cells. This leads to a rejuvenation of the entire RBC population and young RBC are known to show a higher RBC deformability (Mairbaurl, 2013). Though, athletes of endurance sports tent to show highest deformability which is in line with previous studies (Smith et al. 1999). Further studies are necessary to understand the underlying mechanisms which affect RBC function und its importance in athletic performance.
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MIR-214 AND MIR-126 WERE ASSOCIATED WITH RESTORATION OF ENDOTHELIAL FUNCTION IN YOUNG OBESE ADULTS AFTER EXERCISE AND DIETARY INTERVENTION

HU, M., WANG, S., LIAO, J.W., HUANG, J.H.
GUANGZHOU SPORT UNIVERSITY

Introduction
Obesity usually result in increased cardiovascular morbidity including endothelial destruction, and miRNAs are recognized as potent regulators on endothelial function. We therefore explored pivotal miRNAs before and after exercise and dietary intervention in young obese adults and examined their potential relationships with selected endothelial function and biomarkers.
Methods
Seventeen young obese adults (22.1 ± 0.9 yr) were included in an exercise and dietary intervention training program for 2 months. At the beginning and the end, measurements of anthropometric and brachial artery's flow-mediated dilation were performed. Endothelial progenitor cells, endothelial related biochemicals and circulating miR-214 and miR-126 levels were also determined.
Results
After the intervention, the subjects body weight and BMI significantly decreased from 116.6 ± 6.0 kg to 103.4 ± 5.4 kg ($P<0.001$) and from 37.8 ± 1.2 kg/m2 to 33.5 ± 1.1 kg/m2 ($P<0.001$) respectively. Circulating miR-214 and miR-126 levels was significantly enhanced ($P<0.05$) along with improved endothelial function. The relationship between relative changes of miR-214 and that of endothelial progenitor cells was significant ($r=0.589$, $P<0.05$). There was also a correlation between relative changes of miR-126 and that of endothelial nitric oxide synthase ($r=0.433$, $P<0.05$).
Discussion
miR-126 in plasma and circulating blood cells has great positive influences on vascular function. miR-214 is highly expressed in endothelial cells, and functions to regulate angiogenesis through several angiogenic factors. The endothelial related miR-214 and miR-126 could be enhanced by exercise combined with dietary intervention in obesity, and these molecular adaptations are associated with improved endothelial function during the process. These findings increase our understanding of the molecular mechanisms underlying lifestyle modifications on endothelial dysfunction during obesity.
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Contact
whoomin@hotmail.com

AQUATIC EXERCISE DECREASES ARTERIAL STIFFNESS AFTER TRAINING CAMP IN FEMALE ATHLETES

KAORI, S.1, RYOTA, K.2, YUTO, H.3, HIROYUKI, H.3, RISAKO, T.3, KEN, N.3, TAKANOBU, O.3
INTERNATIONAL CHRISTIAN UNIVERSITY

Introduction
Arterial stiffness increases significantly after participation in training camps involving greater training volume. Increased arterial stiffness reduces with land exercises, such as running, walking, and/or cycling. However, little is known about the association between aquatic exercise and arterial stiffness. The aim of this study was to investigate the effect of aquatic exercise on arterial stiffness after participation in a training camp by female athletes.
Methods
The participants in this study were 14 female collegiate volleyball players who participated in a summer training camp. None of the participants were taking oral contraceptives. As part of the training camp, they took part in daily volleyball sessions (training for technique or strategy) and non-volleyball sessions (training for physical fitness). One day after the training camp, the aquatic exercise (AE) group (n=6) performed swimming, dynamic stretches, and static stretches in the water, while the land exercise (LE) group (n=8) performed moderate-intensity cycling (corresponding to 50% heart rate reserve), for 30 min. Brachial-ankle pulse wave velocity (baPWV), an index of arterial stiffness, was measured using an automatic waveform analyzer with sensory cuffs wrapped around both brachia and ankles. baPWV was measured before the training camp (baseline), after the training camp, and after exercise in water or on land.
Results
baPWV increased significantly after the training camp in both groups. However, baPWV in the AE group decreased significantly after aquatic exercises compared with after the training camp ($P<0.05$), whereas baPWV in the LE group did not change from the values after the training camp despite performing land exercises.
Discussion
Systemic PWV is known to decrease after a single bout of aerobic cycling (Kingwell et al. 1997). However, training camp-induced increases in arterial stiffness did not decrease with land exercise (aerobic cycling), whereas aquatic exercise decreased it. Water pressure squeezes the surface veins and increases venous return, which promotes systemic blood circulation (Suzuki, 2008). Therefore, aquatic exercises may be an effective exercise prescription for decreasing arterial stiffness after training camp participation. The present findings indicate that aquatic exercise decreases arterial stiffness after a training camp to a greater extent than land exercise.
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Contact
ksato.swim@gmail.com

Conventional Print Poster

CP-PM13 Muscle injuries and damage

ENERGY ABSORPTION STRATEGY IN THE LOWER EXTREMITY BY KNEE VALGUS/VARUS ALIGNMENT DURING VERTICAL JUMPS

TAMURA, A.1,2, AKASAKA, K.1,3, OTSUDO, T.1,3

1: SAITAMA MEDICAL UNIVERSITY GRADUATE SCHOOL OF MEDICINE, 2: SEKISHINDO HOSPITAL, 3: SAITAMA MEDICAL UNIVERSITY

Introduction
Knee valgus alignment during landings of drop vertical jumps has been associated with an increased risk of non-contact anterior cruciate ligament injuries. To prevent knee injuries, the impact imposed on the knee joint during landings must be attenuated by soft landings in the lower extremity joints. Therefore, the purpose of this study was to examine whether knee valgus alignment during landings influences kinetic parameters and energy absorption strategy in the lower extremity.
Methods
The study included 17 female college students, who performed the drop vertical jump. Lower extremity kinetics and kinematics data were obtained from the 3-D motion analysis system. Participants were divided into the valgus (N=10) and the varus group (N=7), according to knee angle in the frontal plane during the deceleration phase of drop vertical jumps. The angular impulses of the hip, knee, and ankle joints were calculated by integrating the joint moment–time curves during the deceleration phase. The total negative works of the hip, knee, and ankle joints during the deceleration phase were calculated by integrating the joint power–time curves and defined as the energy absorption. Unpaired t tests were used to compare changes in the variables between two groups.
Results
The knee angular impulse in the valgus group was significantly greater than that in the varus group (valgus; 0.119±0.020 Nms/kgm, varus; 0.098±0.025 Nms/kgm, $p<0.05$), while the hip (valgus; 0.030±0.026 Nms/kgm, varus; 0.082±0.032 Nms/kgm, $p<0.01$) and ankle angular impulses (valgus; 0.139±0.019 Nms/kgm, varus; 0.165±0.025 Nms/kgm, $p<0.05$) in the valgus group were significantly smaller than those in the varus group. The total negative work on the knee joint in the valgus group was significantly greater than that in the varus group (valgus; -1.02±0.14 W/kg, varus; -0.96±0.26 W/kg, $p<0.05$), while that on the hip joint was significantly smaller (valgus; -0.13±0.13 W/kg, varus; -0.36±0.19 W/kg, $p<0.01$). There was no difference between the two groups in that on the ankle joint ($p<0.05$).
Conclusion
The negative work at the lower extremity joints represents energy absorption through eccentric muscular contractions during the deceleration phase of drop vertical landings. The result of this study indicated that energy absorption during landings with knee valgus depended on the knee joint, whereas the hip joint was a smaller contributor to energy absorption than landings with knee varus. This finding suggests the importance of energy absorption by the hip joint to decrease the mechanical stress on the knee joint during landings.
Contact
a.tamura.dp@gmail.com

ALIGNMENT OF TRUNK AND LOWER EXTREMITY DURING STAR EXCURSION BALANCE TEST MIGHT BE USEFUL FOR EVALUATION OF ACL INJURY RISK

UEBAYASHI, K.1, AKASAKA, K.2,3, TAMURA, A.2, OTSUDO, T.2,3, SAWADA, Y.3, OKUBO, Y.2,3

1: SUZUKI CLINIC ORTHOPEDICS RIVER CITY (TOKYO, JAPAN), 2: SAITAMA MEDICAL UNIVERSITY GRADUATE SCHOOL OF MEDICINE (MOROYAMA, JAPAN), 3: SAITAMA MEDICAL UNIVERSITY (MOROYAMA, JAPAN).

Introduction
There are many studies reported that anterior cruciate ligament (ACL) injuries were evaluated by knee alignment in a short period of time such as that during jump landing. We considered that alignment of trunk and lower extremity in a comparative long period of time during Star Excursion Balance Test (SEBT) might be useful to evaluate ACL injury risk. Therefore, the purpose of this study was to clarify the relationship of knee valgus alignment during a single leg drop vertical jump (SLDVJ) and alignment of trunk and lower extremity during SEBT.
Methods
30 healthy females volunteered to participate in this study. The 3D motion analysis system was used to measure trunk, hip and knee angles during SLDVJ and SEBT. All participants were divided into the valgus and varus groups by the alignment of the knee in frontal plane during SLDVJ. Trunk, hip and knee angles of supporting leg were analyzed from the starting position to the maximum reach during SEBT. An independent t-tests were used to identify differences of trunk, hip and knee angles during SEBT between two groups.
Results
The knee valgus angles in valgus group were greater than those in varus group during reach direction of anterior (A), anterior medial (AM), anterior lateral (AL), medial (M), and posterior medial (PM), respectively ($p<0.05$). In addition, the knee internal rotation angle in valgus group was less than that in varus group during reach direction of AM ($p<0.05$). Furthermore, the trunk flexion and rotation angles toward supporting leg in valgus group were more than those in varus group during reach direction of AM ($p<0.05$).
Conclusion
Our findings indicated that a decrease of knee internal rotation angle might avoid an unbalanced posture in lower extremity and an excessive tension force applied on the ACL. In addition, increases of trunk flexion and rotation angles toward the supporting leg with knee valgus were also recognized in reach direction of AM during SEBT. These increases of trunk flexion and rotation angles were considered to compensate motion to maintain the center of gravity within base of supports. Comparing to jump and cutting maneuvers, alignment of trunk and supporting leg in reach direction of AM during SEBT might be one of ACL injury risk found as a characteristic influenced by SEBT. Our results indicate that reach direction of A, AM, M, PM and AL during SEBT might be useful to evaluate ACL injury risk.
Contact
kazuma.uebayashi@gmail.com

KNEE ROTATION RELATED TO GENDER, KNEE ANGLE AND APPLIED TORQUE

SEIYA, M., SHUNPEI, M.

NIIGATA UNIVERSITY OF HEALTH AND WELFARE

Introduction
Rotational knee laxity is known as an intrinsic risk factor for anterior cruciate ligament (ACL) injury. However, there was no convenient way to measure rotational range of motion (R-ROM). To this end, we developed the RotorMeter, a simple and non-invasive external device intended to measure R-ROM of the knee, which we reported to be reliable and valid at the ACSM2016 Annual Meeting. The purpose of this study is to use the RotorMeter to clarify the characteristics pertaining to R-ROM of the knee in healthy subjects under varying conditions.
Methods
A total of 10 healthy women (20 knees, 20.8 ± 1.8 years) and 10 men (20 knees, 20.2 ± 2.1 years) participated in the study. Torques of 2.5 Nm, 5 Nm and 7.5 Nm were applied at 90°, 60°, and 30° angles of knee flexion and the examiner's apprehension of End-Point-Feel (EPF) was used to measure full range of motion using the RoterMeter. Students t-tests, paired t-tests and one-way ANOVA was used for statistical analysis by SPSS® software.
Results
The females showed larger total (internal + external) R-ROM than the males ($p<0.05$), and no laterality was observed at any flexion angle and applied torque. When different torques were applied at the same flexion angle, total R-ROM significantly increased at all flexion angles with increased torque. Furthermore, with regard to EPF, a significant difference was observed only in comparison with 2.5 Nm. When the same torque was applied at different flexion angles, a significant difference was observed only between 90° and 30° when a torque of 2.5 Nm was applied, whereas when torques of 5Nm, 7.5 Nm and EPF were applied, no significant difference in R-ROM was observed at any of the flexion angles.
Discussion
We could find that females show greater knee R-ROM than males and found no laterality. Knee R-ROM increased when greater torque was applied, but it was not affected by the knee flexion angles during the measurement. These results support the present study (Almquist et al, 2012).
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ASSOCIATION ANALYSIS OF ACTN3 R577X POLYMORPHISM WITH MUSCLE STIFFNESS AND MUSCLE STRAIN INJURY

MIYAMOTO-MIKAMI, E.1, HIRATA, K.1, FUKU, N.2, KIMURA, N.1, MIYAMOTO, N.1

1: NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA (KAGOSHIMA, JAPAN), 2: JUNTENDO UNIVERSITY (CHIBA, JAPAN)

Introduction
Muscle stiffness is considered to be one of the primary contributors to joint flexibility (Magnusson et al. 1997) and to influence muscular injury risk (Witvrouw et al. 2003). A previous study showed that R577X polymorphism in α-actinin-3 gene (ACTN3) was associated with joint flexibility assessed by sit-and-reach in 2 different cohorts (Kikuchi et al. in press). In skinned fiber experiments, the ACTN3 R577X genotype was associated with passive muscle stiffness (Broos et al. 2012). Thus, we hypothesized that the ACTN3 R577X polymorphism influences joint flexibility and injury risk through passive muscle stiffness.
Methods
Seventy-seven healthy young male subjects were genotyped for the ACTN3 R577X (rs1815739) polymorphism using TaqMan SNP Genotyping Assay. Passive stiffness of each muscle of the hamstring (biceps femoris, semitendinosus, and semimembranosus) of the right leg was assessed in a seated position using ultrasound shear wave elastography. All subjects were completed a questionnaire including information on history of hamstring strain injury, regular stretching and dominant leg.
Results
Genotype frequencies of the ACTN3 polymorphism (RR: 26.0%, RX: 51.9%, and XX: 22.1%) were in Hardy-Weinberg equilibrium. The proportions of subjects conducting stretching exercise regularly and leg dominance did not differ among the ACTN3 R577X genotypes. Passive stiffness of the biceps femoris did not differ among the ACTN3 R577X genotypes, whereas R allele (RR+RX genotype) carriers showed significantly greater passive stiffness of the semitendinosus and semimembranosus than XX genotype carriers (semitendinosus: 30.4 kPa vs. 26.0 kPa, semimembranosus: 45.5 kPa vs. 38.3 kPa, $P < 0.05$). Frequencies of subjects with history of hamstring strain injury did not differ between the ACTN3 R577X genotypes (R allele carriers: 20% vs. XX genotype carriers: 23.5%, $P > 0.05$).
Discussion
The present finding on association between the ACTN3 R577X genotype and passive muscle stiffness is consistent with the previous in-vitro study (Broos et al. 2012). On the other hand, contrary to our hypothesis, no association was observed between the ACTN3 R577X genotype and history of hamstring strain injury. These results suggest that deficiency of α-actinin-3 in fast-twitch muscle fibers alters the mechanical property of the semitendinosus and semimembranosus while the altered mechanical property of these muscles might not influence the risk of hamstring strain injury.
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Contact
e-miyamoto@nifs-k.ac.jp

INVESTIGATION OF CONTRALATERAL ARM DESIGN FOR ASSESSING MUSCLE DAMAGE IN HUMANS

CHINO, K., TANABE, Y., TAKAHASHI, H.
JAPAN INSTITUTE OF SPORTS SCIENCES

Introduction
When investigating the effect of interventions on exercise-induced muscle damage in humans, contralateral arm design is used to eliminate genetically heterogeneous molecular noise. In experimental design, it is important to apply equivalent loads to muscles of both arms.
Methods
Therefore, to investigate contralateral arm design for assessing muscle damage in humans, this study evaluated exercise parameters during eccentric exercise in the dominant (DOM) and non-dominant (NDOM) arms in the unfatigued state. Eight male and 3 female subjects (age, 32.3 ± 3.5 years; height, 168.2 ± 9.4 cm; body mass, 62.6 ± 6.8 kg) performed three maximal voluntary eccentric elbow flexions at 60, 120, and 180°·s-1 using their DOM and NDOM arms. The averages of peak torque, work, and electromyographic activity of the biceps brachii were obtained, and the repeatability of these parameters was determined by the coefficient of variation (CV). To normalize peak torque and electromyographic activity during the eccentric exercise, maximal voluntary isometric (MVI) elbow flexion was performed at an angle of 90°.
Results
Peak eccentric torque normalized to MVI torque was not significantly different between the DOM and NDOM arms at 60°·s-1 (DOM, 102 ± 9% MVI; NDOM, 105 ± 11% MVI), 120°·s-1 (DOM, 98 ± 9% MVI; NDOM, 99 ± 10% MVI), or 180°·s-1 (DOM, 98 ± 10% MVI; NDOM, 98 ± 9% MVI) (P = 0.72). The CV for peak torque was not significantly different between the arms at 60°·s-1 (DOM, 5.0 ± 2.5%; NDOM, 4.1 ± 1.8%), 120°·s-1 (DOM, 4.3 ± 2.3%; NDOM, 3.0 ± 1.5%), or 180°·s-1 (DOM, 4.6 ± 2.7%; NDOM, 5.3 ± 3.0%) (P = 0.46).Work per one eccentric elbow flexion at 60°·s-1 (DOM, 82 ± 27 J; NDOM, 76 ± 25 J), 120°·s-1 (DOM, 79 ± 28 J; NDOM, 74 ± 27 J), and 180°·s-1 (DOM, 79 ± 25 J; NDOM, 72 ± 26 J) was significantly different between the arms (P = 0.04). The difference in the CV for the work between the arms was not significant at 60°·s-1 (DOM, 5.8 ± 1.9%; NDOM, 5.2 ± 1.9%), 120°·s-1 (DOM, 4.9 ± 2.5%; NDOM, 4.7 ± 2.4%), or 180°·s-1 (DOM, 5.2 ± 3.1%; NDOM, 9.9 ± 7.6%) (P = 0.56). Electromyographic activity did not significantly differ between the arms at 60°·s-1 (DOM, 102 ± 20% MVI; NDOM, 83 ± 19% MVI), 120°·s-1 (DOM, 98 ± 21% MVI; NDOM, 92 ± 28% MVI), or 180°·s-1 (DOM, 95 ± 26% MVI; NDOM, 87 ± 33% MVI) (P = 0.14). The CV for electromyographic activity was also not significant between the arms at 60°·s-1 (DOM, 9.7 ± 4.2%; NDOM, 8.8 ± 3.1%), 120°·s-1 (DOM, 11.9 ± 4.8%; NDOM, 11.5 ± 5.7%), or 180°·s-1 (DOM, 12.5 ± 6.6%; NDOM, 10.8 ± 6.6%) (P = 0.59).
Discussion
Except for work, exercise parameters did not significantly differ between the DOM and NDOM arms during eccentric exercise, which suggests that the contralateral arm design is usable for assessing the effect of interventions on muscle damage.

INJURY SURVEILLANCE OF NON-PROFESSIONAL SALSA DANCE

DOMENE, P.A.1, STANLEY, M.1, SKAMAGKI, G.2
COVENTRY UNIVERSITY

Introduction
Salsa dance is a popular leisure activity participated in by both women and men. In terms of community-based physical activity and psychosocial health promotion, salsa dance has been demonstrated to be efficacious as a physical and mental health-enhancing activity in non-professional performers (Domene et al., 2014; Domene et al., 2016). Currently, however, no empirical work has been published in the peer-reviewed literature describing the injury surveillance of this particular dance genre. Therefore, we sought to i) establish the extent of injuries, ii) determine the odds of sustaining an injury, and iii) calculate the injury incidence rate in non-professional salsa dance.
Methods
Salsa dancers were invited to complete an anonymous web-based survey containing 11 demographic background and 10 (1 yr retrospective) injury history questions. Inclusion criteria stated that the respondents had to be aged 18 - 64 yr, be currently involved in salsa dance as a non-professional, and have at least 1 yr of salsa dance experience. Binomial logistic regression analysis was used to predict the odds of injury during salsa dance. Mann-Whitney tests were employed to ascertain differences between groups. Categorical data were analysed using Pearson chi-square tests of independence.
Results
The survey response rate was 77%. The final sample of respondents included 303 women and 147 men, of which 22% and 14%, respectively, sustained one or more injuries during salsa dance in the past year. The median (Q1 - Q3) number of injuries was 1 (1 - 1) for both women and men and the majority (women = 67%, men = 57%) of injuries were minor in severity. The odds of injury was 2.00 (95% CI 1.14 - 3.50) times greater ($p < 0.05$) for women than for men. Age, body mass index, and salsa dance experience were also found to be significant ($p < 0.05$) predictors of injury. The injury incidence rate for women and men was 1.1 (95% CI 0.9 - 1.4) and 0.5 (95% CI 0.3 - 0.7) injuries per 1000 h of exposure, respectively.
Discussion
This is the first study to have described female and male adult non-professional salsa dancers in terms of their injury history profile. Our results indicate that the likelihood of sustaining an injury during salsa dance is similar to that of ballroom (Kuisis et al., 2012), but lower than that of Spanish (Echegoyen et al., 2010) and aerobic dance (Garrick et al., 1986).
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CONFORMITY BETWEEN MUSCLE HARDNESS TESTER AND O-RING TEST RESULTS

CHOI, H.S., LEE, J.H.
DONG-EUI UNIVERSITY

Introduction

Tanaka Nobunaka suggested that the O-ring test, a method developed by Omura to detect organ abnormalities and circulatory disturbances, may also be used to identify areas with increased muscle hardness.1-2) Accordingly, this study used a muscle hardness tester (MHT) on the same region of the left and right trapezius muscles to determine whether MHT results would be in agreement with those of the O-ring test.
Methods
Forty asymptomatic adults in their 20s were enrolled. With the participant sitting upright on a chair,3) examiner 1 applied the MHT to the center region of the right and left trapezius muscles three times, and used the mean value to determine the side with greater muscle hardness. Examiner 2 conducted the O-ring test on the same regions to determine which side had greater muscle hardness. The order of MHT and O-ring testing was randomly assigned for each participant. Cohen's Kappa coefficient was used to measure agreement between the two measurements. The level of significance was set to $p<0.05$. All statistical analyses were performed using SPSS 18.0 software.
Results
The MHT and O-ring test results were in agreement ($p<0.001$), and the Kappa coefficient was significant at 0.867.
Discussion
As per the interpretation by Landis and Koch, the computed Kappa coefficient indicated that the measurements were in almost perfect agreement. This suggests that the O-ring test is another clinically applicable device, in addition to the MHT, for detecting regions with relatively higher muscle hardness.
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Contact
dreampt@hanmail.net

ACUTE EFFECTS OF FOAM-ROLLING ON VOLUME ALTERATIONS OF THE LOWER LIMBS AND PERCEIVED PAIN

KÜHNEMANN, M., PRAEGER, A., BAUMGART, C., HOPPE, M.W., FREIWALD, J.
BERGISCHE UNIVERSITÄT WUPPERTAL

Introduction
Foam-Rolling (FR) is used in sport and therapy during warm-up and regeneration procedures (Schroeder & Best, 2015) as well as in the treatment of myofascial disorders (Schleip et al., 2012). However, the high mechanical pressure inducted physiological effects of FR on the underlying tissue and associated potential risks are unknown (Freiwald et al., 2016). Therefore, this study aimed to investigate the acute effects of FR on volume alterations of the lower limbs and perceived pain.
Methods
27 males (27.6±4.3 yrs; 181±6 cm; 88.2±13.6 kg) executed 2x30 repetitions of FR at the calf and also at the anterior, posterior, and lateral thigh of the dominant leg. The non-dominant leg act as control. Pre, post, and 15 min post FR, the volume of the lower limb was measured with an optoelectronic scanner (Pero-System Messgeräte GmbH, Wuppertal, GER). To localize segmental alterations, the lower limb was divided into the thigh, knee, and calf. Perceived pain was measured via a visual analog scale. While volume alterations were investigated by a repeated ANOVA and following-up T-tests, perceived pain was examined by a Wilcoxon-Test. The significance level was defined as $p<.05$.
Results
A significant main effect was observed for the volume of the calves on the treated ($p=.011$) and non-treated leg ($p=.001$). Thereby, the volume of the treated leg significantly decreased post (-0.9%, $p=.026$) and keep reduced 15 min post FR (-0.9%, $p=.005$). The volume of the non-treated leg also significantly decreased at both time points (post: -1.0%, $p<.001$; 15 min post: -1.05%, $p<.001$). Finally, there was also a significant decrease for the perceived pain between the first and second set of FR for the anterior, posterior, lateral thigh, and calf ($p<.001$).
Discussion
Since our findings show that FR does also influence the volume of the non-treated leg, it can be speculated that this observation is caused by central mechanisms (e.g., vasoconstriction via sympathetic activation), for example, according to the perceived pain. Future studies are warranted to clarify this hypothesis.
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Contact
m.kuehnemann@outlook.de

EFFECT OF LOWER LEG BALANCE TAPING ON BODY BALANCE

KIM, J.W., LEE, J.H.
DONG-EUI UNIVERSITY

Introduction
To effectively maintain body balance, it is necessary to achieve stability in the muscles around the ankle joints (Yaggie & McGregor, 2002). Many studies are being conducted using elastic tape to correct body balance, in order to control musculoskeletal disease and pain. However, evidence for the application of balance taping to improve balance is still lacking, with the conducted methods remaining ambiguous. Moreover, when balance taping is applied directly to the lower legs, which is one of the most important elements for maintain-

ing balance, the results are expected to differ. Accordingly, the present study aimed to investigate the immediate effect of applying spirally patterned balance taping to the lower legs on body balance.
Methods
The participants in the present study comprised 36 healthy adults of both sexes in their 20s, who did not have any neurological or musculoskeletal injuries. The participants were randomly assigned into two groups; the experimental group, where spirally patterned balance taping was applied to the lower legs, and the control group, where placebo taping was applied. The BioRescue Romberg Test was used to measure the static and dynamic balance of the participants before and after taping. Data was analyzed using SPSS 22.0 for Windows, and the p value for significance in statistical testing was set to 0.05. A paired t-test was performed to compare the within-group changes in static and dynamic balance before and after taping. The independent t-test was performed to compare the changes in static and dynamic balance between the experimental and control groups.
Results
When spirally patterned balance taping was applied, static and dynamic Romberg Test results indicated that the participants center of pressure (COP) showed a significant change in movement area, length, and speed ($p<0.05$). In the control group, dynamic Romberg Test results indicated significant differences only in movement length and speed ($p<0.05$), with all other parameters showing no significant differences.
Discussion
A recent study showed no immediate effects of applying kinesiology tape to the ankles of soccer players on the improvement of balance and proprioception (Bailey & Firth, 2016). However, the present study showed an immediate and significant effect on all parameters in the static and dynamic balance tests, when spirally patterned balance taping was applied to the lower legs. Therefore, this indicates that the method described in the present study can serve as an intervention method that can have immediate effects on the balance of patients with diminished balance, as well as healthy people with weakened balance ability.
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Contact
Jung-Hoon Lee, e-mail: dreampt@hanmail.net

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CP-PM14 Internal medicine

BODY COMPOSITION CHANGES AFTER RESISTANCE, AEROBIC AND COMBINED TRAINING AND DETRAINING IN CORONARY ARTERY DISEASED PATIENTS

PANAYIOTOU, G., VOLAKLIS, A.K., TOKMAKIDIS, P.S., DOUDA, E., TOUBEKIS, G.A., SMILIOS, I., MAKRIS, A., JAMURTAS, A.
EUROPEAN UNIVERSITY OF CYPRUS

Introduction
Every year an increasing number of individuals are diagnosed suffering from coronary artery disease while this disease is the number one cause of death worldwide. For combating the risk factors of coronary artery disease many investigations recommended as important factors the exercise training and the avoidance of sedentary life style (Tully et al., 2005; Booth et al., 2012).
Methods
60 males with coronary artery heart disease were randomly assigned into the resistance exercise group (n=11), the aerobic exercise group (n=18), the combine exercise group (n=16) and the control group (n=15). The three exercise groups carried out 8 months of resistance, aerobic or combine training consisting of 3 exercise sessions per week. Before the beginning of the study, after 4 and 8 months of training and after 1, 2 and 3 months of detraining total body mass and relative body fat were determined.
Results
No differences were found between the groups on physical characteristics at baseline ($P > 0.05$). For body mass and body fat, a significant interaction between group × time and a main effect of time was found. Compared to baseline, after 8 months of training body mass decreased 3.2%, 2.8% and 4.3% in the aerobic, resistance and combined group, respectively. Body mass remained decreased throughout the three months of detraining for the aerobic and combined exercise group. Body fat decreased in all groups at month 4 and month 8 compared to baseline values. The observed reductions were 4.1% for the aerobic group, 3.5% for the resistance group and 3% for the combined group. During detraining, body fat remained reduced only at month 1 in the aerobic group.
Discussion
The purpose of the present investigation was to compare the effects of three types of chronic exercise on body composition in aged patients suffering from cardiac artery disease. It was found that 8 months of aerobic or combined exercise caused significant decreases in percentages of body fat which retained 3 months following training in aerobic and combined (aerobic and resistance) groups. The above finding is considered of significant importance towards the control of risk factors for CVD development, taking into account that the current overconsumption of food products of poor nutritional value combined with our sedentary lifestyle have contributed to the emergence of new drivers of CVD risk: obesity and type 2 diabetes mellitus (Després, 2012).
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EFFECT OF INTRADIALYSIS EXERCISE PROGRAM ON PHYSICAL FITNESS IN CHRONIC KIDNEY DISEASE

COBO VICENTE, F., PEDRERO, R., VÁZQUEZ, P., ALBA, A., APARICIO, R., SANTIAGO, C., GÓMEZ-GALLEGO, F., PALACIOS, G., DÍAZ, R., MELENDEZ, A., BARRIOS, L., BOTELLA, A., GONZÁLEZ-GROSS, M., PÉREZ-RUIZ, M.

UNIVERSIDAD EUROPEA

Introduction
Sedentary time, intolerance to exercise and catabolic state in chronic kidney disease (CKD) induce to decreasing of muscle mass, fitness and quality of life in hemodialysis patients.
Objective
The aim of this study was to check the grade of enforcement and to assess the effect of an exercise program on fitness and health in hemodialysis patients
Material and Methods
An intervention study was performed in three centers of 'Íñigo de Álvarez de Toledo' Kidney Foundation (FRIAT). From 235 initially eligible patients, 54 fulfilled the inclusion criteria, 11 left the study, 14 were female, so 29 male subjects completed the intervention. The clinical diversity of patients induced to develop an intragroup experimental design, with 2 periods of 14 weeks, the first one without exercise (A-B period) and the next one with exercise (B-C period). The program included both aerobic and strength exercise p in sessions of 60 minutes, 3 days per week. Cardiovascular (CV) and strength fitness were assessed by: '6 minutes walk test' (6MWT), 'hand grip strength ', "30 and 60-second chair stand test" (STS30 y STS60) y "sit-to-stand-to-sit test" (STS10).
Results
A statistically significant decrease in all fitness parameters was observed from A to B period. From B to C period, this decrease stops, due to the intervention of exercise program, without significance improvement.
Conclusion
Intradialysis exercise program is important to reduce the loss of fitness associated to the CKD. Future studies should help to find an effective workload.
Acknowledgements
The authors would like to thank "Iñigo Alvarez de Toledo" Kidney Foundation (FRIAT) for the help to recruit the patients. This work was supported in part by Catedra Real Madrid-UEM (ref. P2016/RM10).

IMPACT OF PHYSICAL INACTIVITY ON THE RISK OF DEVELOPMENT HEPATIC STEATOSIS IN WOMEN

SÁ PINTO MONTENEGRO, C., POLITO, L.F.T., PITTA, R.M., MAREGA, M., CARVALHO, J.A.M., CESCHINI, F., BOCALINI, D., FIGUEIRA JUNIOR, A.J.

HOSPITAL ISRAELITA ALBERT EINSTEIN

Introduction
Physical inactivity is associated to development of metabolic diseases, according to World Health Organization. The Nonalcoholic Fatty Liver Disease (NAFLD) is the most prevalent liver disease in adults, and can progress and be characterized as hepatic steatosis (HS) that is derived from the accumulation of lipids in hepatocytes. Purpose: The purpose of this study was to determine the impact of physical inactivity on the risk of development hepatic steatosis.
Methods
This study evaluated 454 women (36.6± 6.2 years) with body mass index (BMI) of 23.14kg/m2 (±3.35) who participated in the Protocol of Preventive Medicine Check-up at Albert Einstein Israelita Hospital (Brazil) from January to October 2011. We applied the International Physical Activity Questionnaire (IPAQ) to determine the physical activity level (classified Inactive (INACT) women who do not accumulate 150 minutes of physical activity weekly; Active women (ACT) who accumulate 150 minutes of physical activity weekly) and ultrasound examination to diagnose the hepatic steatosis presence. The statistical analysis was based in Mann Whitney U test and Wald test. We considered the $p<0.05$ as significance and Poison multivariated correlation with 95% confidence index.
Results
According to the logistic regression, HS presented 6.48 higher risck in INACT than ACT. The same trend was observed to the HS adjusted for age x INACT with 7.34 associated risck. Both association were higher than BMI adjustment ratio (5.33). Adjusting physical activity for the presence of metabolic syndrome, the odds ratio of inactive women goes to 5.92 in relation to active women.
Discussion
Data showed us to that physical activity presented a protection on the development oh HS in women.

THE BENEFITS OF REGULAR PHYSICAL ACTIVITY ON DOXORUBICIN-INDUCED KIDNEY COLLAGEN DEPOSITION ON RATS

CARDOSO, D., BOVOLINI, A., ROLIM FILHO, N., DUARTE, J.A.

FACULDADE DE DESPORTO DA UNIVERSIDADE DO PORTO

Introduction
It is widely accepted that regular physical activity (RPA) is effective on the prevention and treatment of several diseases. Doxorubicin (DOX), an anthracycline used in chemotherapy to treat cancer [1], has many side effects, being one of them the collagen deposition (CD) in kidneys, decreasing their function [2]. However, swimming exercise during 11 weeks decreased kidney collagen levels on healthy rats, improving their function and structure [3, 4]. So, the aim of this study was to verify if RPA is able to revert the CD induced by a prolonged DOX administration, mimicking a chemotherapy protocol, on healthy rats.
Method
Twenty-four male Wistar rats were randomly divided into two groups: DOX and sterile saline solution (SSS). DOX group received weekly an intraperitoneal injection of DOX (2 mg/kg) for seven weeks, while CON group received SSS. Two weeks after the last injection, these groups were subsequently divided into sedentary (n=6; DOXsed; n=6; CONsed) and active group (n=6; DOXex; n=6; CONex). Active groups had unrestricted free wheel running access whereas the sedentary groups remained restricted to their cage space during 2 months. At the end of protocol animals were euthanized and kidneys, stained with Sirius red, were histologically examined.
Results

The results reveal higher levels of CD on the kidney tissue of the DOXsed group than on the CONsed group (p<.05). In addition, there is a collagen decreased content in the DOXex group compared to the CONex (p<.05).
Discussion
Renal fibrosis is associated with chronic cell injury and kidney dysfunction [5]. In our study, although the DOX-induced cellular damage with kidney fibrosis, the CD levels of DOXex group decreased after 2 months of voluntary regular exercise. These results suggest that RPA seems to buffer the negative effect of DOX on CD on kidney tissue, decreasing their levels and improving kidney structure.
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Contact
daniielafcardoso@gmail.com

PRE-PARTICIPATION CARDIAC SCREENING IN ATHLETES-10 YEARS' <2007-2017> EXPERIENCE

STOIAN, I.M., IONESCU, A., STOIAN, I.

"PROF.C.C ILIESCU" EMERGENCY CARDIOVASCULAR DISEASES INSTITUTE, NATIONAL INSTITUTE OF SPORTS MEDICINE, NATIONAL INSTITUTE OF SPORTS MEDICINE

Introduction
Cardiac Preparticipation(PPE) screening is the first important step to identify underlying cardiac disorders predisposing to sudden cardiac death (SCD), catastrophic injury(1,2).The checklist for athletes already exist, the sport team physicians being able to put into practice(4).
Method
PPE examination(comprehensive history questionnaire,physical exam) conducted by the sport team physicians(STP) at the beginning of sport activity, prior to organized athletic competition, follow-up. Screening protocol: 12-point personal/family history; physical exam; electrocardiography(ECG).Detraining, according to rules. Complex cardiac (echocardiography,coronarography, CT/MRI) tests when necessary(3). Material. 2007-2017,STP exams:1920 athletes (78.3% M, age16-29yo.Caucasian 95%,Africans 5%).Sports-endurance (rowing,canoeing,cycling,football).
Results
Athletes' Clinical exam/ECG: Gr.I.Normal,1323(68.9%).
Gr.II.Abnormal, 597(31.1%).Cardiac evaluation/ Diagnosis for Gr.II: Normal athletes,436 (73.03%).Pathology: 6(1.005%) athletes, hypertrophic cardiomyopathy;1(0.16%) arrhythmogenic right ventricular cardiomyopathy; 1(0.16%) anomalous coronary artery origin; 15(2.51%) WPW; 2(0.3%) Brugada syndrome; 2(0.25%) ventricular tachicardias; 125(20.%) ventricular hypertrophy; 9(1.5%) aortic valve stenosis. One (0.16%) hypertrophic cardiomyopathy athlete, SCD during competition.
Discussion
Cardiac examination is a mandate part of PPE. Complex medical examination conducted by STP and cardiology team revealed normal athelets in 91.6% athletes. However,161(26.9%) athletes had cardiac diseases, of which,12 (2.01%) with increased risk of SCD. One (0.16%) hypertrophic cardiomyopathy athlete, SCD during effort. Conclusion.The PPE evaluation if done timely, correctly, can help prevent life-threatening cardiac problems.
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FEASIBILITY OF MYOCARDIAL PERFUSION SPECT IN DIAGNOSTICS OF NONCORONARY DISMETABOLIC HEART DISEASES IN ATHLETES

BONDAREV, S.A.1, SUKHOV, V.YU2, DIDUR, M.D.3

1GBOU VPO SPBGPMA, HEALTH MINISTRY OF RUSSIA, FGBOU SZGMU NAMED AFTER MECHNICOV HEALTH MINISTRY OF RUSSIA (ST.PETERSBURG, RUSSIA) 2FGBVOUVPO MILITARY MEDICAL ACADEMY NAMED AFTER SM KIROV, RUSSIAN DEFE

Introduction
Well known SPECT possibilities in diagnostics of cardiac pathology, differentiating of CAD and non-coronary pathology, and identifying myocarditis. Principle of method is to assess violated uptake or washout of radioactive tracers due to transportation system damage or metabolic disturbances in cells. Thus, SPECT is an ideal method for studying the characteristics of metabolic disorders in non-coronary diseases. Our study aimed to analyze the efficiency of SPECT for the diagnostics of a definite non-coronary heart disease - chronic stress-induced cardiomyopathy (HSCMP).
Methods
Main group consisted of 53 men (32.5±1.6 years) with established HSCMP, control group consisted of 32 healthy volunteers of the same age. All of studied individuals underwent psychological and initial cardiologic testing using Luscher, Spielberger (Hanin's modification), and Zung (Balasheva's modification) scales; Rest/Stress (ergometry) ECG-testing, 24-hr Holter ECG-recording; Echocardiography.

SPECT studies with 99mTc-tetrafosmine were performed in all involved persons upon results of basic investigations.
Results
SPECT revealed significant difference in number of sectors with normal and decreased tracer uptake between patients of main and individuals of control group (11.0±5.3 and 16.5±0.2, p <0.01; 4.7±4.3 and 0.4±0,2, p <0,01, respectively).
Discussion
Use of SPECT for diagnostics of metabolic disorders in myocardium, in particular as a result of HSCMP after mental and emotional strain improves diagnosis and has prognostic value for these patients. Most promising is the use of combined SPECT-CT systems for rapid non-invasive differential diagnostics of ischemic and non-coronary myocardial damage.
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Contact
sabondarev@yandex.ru

GENDER DIFFERENCES IN SEVERAL HEALTH INDICES AFTER A SHORT AND MIXED WEIGHT REDUCING PROGRAM

JOFFROY, S., GARNIER, S., VAVELIN, A., SANGUIGNOL, F., MAURIEGE, P.
UNIVERSITÉ PAUL SABATIER - ITO

Introduction
According to the last ObEpi record, 47.3% of French adults are overweight, and 15% of them are obese (Eschwège et al., 2012). Diet and aerobic exercise are considered the cornerstone of obesity management (Johns et al., 2014). In France, short weight reducing programs developed by weight loss centers and under medical supervision consist in modifying eating and physical habits and include psychological counseling. The main objective of this study was to examine the impact of a 3-week mixed weight loss program combining caloric restriction and exercise on body composition, physical condition, resting systolic/diastolic blood pressure (SBP/DBP), health-related quality of life (QoL) and eating behaviors in sedentary, healthy obese men and women (body mass index, BMI, 30 to 45 kg/m2).
Methods
Fifteen middle-aged men (51.2 ± 7.0 years) and 15 women (51.0 ± 6.8 years) (mean ± SD; NS) received a standardized dietary plan estimated as 1400 ± 200 kcal/day, and completed 110 min endurance exercise, 6 days/week, during 3 weeks (Riesco et al., 2009). Anthropometry and body composition, resting SBP/DBP, distance walked to the Six-Minute Walk Test (6MWT), QoL estimated by the SF36 Questionnaire and eating behaviors (restriction, disinhibition, susceptibility to hunger) assessed by the Three-Factor Eating Questionnaire (TFEQ) were determined before and after weight reduction. Analysis of variance was used to detect between gender differences in response to the weight loss program.
Results
Body weight and BMI, fat mass and waist girth as well as resting SBP/DBP decreased (0.0001
Discussion
Our study shows that a short-term weight reducing program combining caloric restriction and physical activity has a favorable impact on several health indices, irrespective of the gender. Men showed, however, greater reductions in abdominal visceral fat and adopted some healthier eating behaviors in response to weight loss, compared to women.
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Contact
sandra.joffroy@univ-tlse3.fr

HEMODYNAMIC RESPONSES IN MAXIMAL AND SUBMAXIMAL STRENGTH TEST IN HYPERTENSIVE ELDERLY

LEITE, T., COSTA, L.1, COSTA, T.1, MENDES, P.1, REIS, C. 1 ABREU, L.1, SIQUEIRA FILHO, M.1, LEITE, R.2
UNIVERSIDADE FEDERAL DO MARANHÃO

Introduction
Resistance training is an important strategy to prevent the deleterious effects of aging especially for those affected by hypertension (CHODZKO-ZAJKO et al., 2009). Maximal and submaximal strength tests have been used to stablish the correct load to prescribe the resistance training program. However, the hemodynamic responses in hypertensive people during the tests, needs to be elucidated. Thus, the aim of the present study was to evaluate the hemodynamic responses in maximal and submaximal strength test in hypertensive elderly.
Methods
The study included 8 controled hypertensive elderly women, sedentary, age 65 ± 4 years, body mass index 28.3 ± 5.8 kg/m², fat percentage 37.2 ± 7.7%. Each participant performed two familiarization sessions and performed the tests and re-tests of one maximal repetition test (1RM) and ten maximal repetitions (10RM) test in the leg press exercise with 48-hours interval between sessions and 7 days between the tests. Results were expressed as Mean ± Standard Deviation. Kolmogorov Smirnov, paired T- Student test, and Anova, one way with Bonferroni post hoc test, was used to analyze the hemodynamic variables. It was adopted 5% α and the statistical package GraphPadPrism® 6.01.
Results
The Intraclass correlation test (ICC) demonstrated a excellent correlation (1RM: R=0.916 and 10RM: R=0.949). No statistical difference were observed for hemodynamic variables systolic blood pressure (10RM:157.3 ±21.0 vs 1RM 149.4±24.2 mmHg), diastolic blood pressure (10RM:88,2±15,7 vs 1RM 80,1±13,9 mmHg), mean arterial pressure (10RM:108,7±15,3 vs 1RM 102,6±15,8 mmHg) and double product (10RM:14856±3738 Vs 1RM 12265*±2988, p=0.007) when compared both tests. The 1RM load was significantly higher in comparison with 10RM Load. (1RM=105.5±23kg vs 10RM=94.0±27kg p=0.003).
Discussion

The results demonstrated that both tests promoted a normal hemodynamic responses, for elderly women. (FLETCHER et al., 2013). Was found a small difference in full load, a possible justification for these findings may be the fact that the elderly women are untrained and do not present adequate neural adaptation that allows them to perform the 1RM with really maximum loads (Cissik,2000). In conclusion, both tests induced normal hemodynamic responses for hypertensive elderly.

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Contact
proftleite@gmail.com

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CP-PM15 Orthopaedics and rehabilitation: mixed session

WHAT IS THE EFFECTIVE STRETCHING POSITION FOR ELONGATING NECK EXTENSOR MUSCLES? AN ULTRASONIC SHEAR WAVE ELASTOGRAPHY STUDY

YANASE, K.1, IKEZOE, T.1, NAKAMURA, M.2, SAEKI, J.1, YAGI, M.1, HIRONO, T.1, TAMEZAWA, T.1, MOTOMURA, Y.1, ICHIHASHI, N.1

1:KYOTO UNIVERSITY 2: NIIGATA UNIVERSITY OF HEALTH AND WELFARE

Introduction
The stretching of neck extensor muscles is often used in neck rehabilitation. Neck extensor muscles have moment arms in three directions: extension, lateral flexion and rotation. Since each muscle has different moment arms (Vasavada et al., 1998), different stretching methods are predicted to be effective for each muscle. However, it is not clear as to which direction stretching is effective for each neck extensor muscle. The purpose of this study is to clarify the effective stretching method for each neck extensor muscle using ultrasonic shear wave elastography.
Methods
The subjects comprised 10 healthy young men (24.8 ± 2.9 years, 172.4 ± 5.0 cm, 64.6 ± 5.0 kg). Passive static stretching was performed randomly at 5 different positions: flexion (F), left lateral bending (LB), flexion + left lateral bending (F+LB), flexion + left lateral bending + right rotation (F+LB+RR) and flexion + left lateral bending + left rotation (F+LB+LR). Shear elastic moduli of the right neck extensor muscles (upper fiber of trapezius, splenius capitis and levator scapulae muscles) were measured using ultrasonic shear wave elastography (SuperSonic Imagine, France) during these stretching and at rest (REST). The increase in the shear elastic modulus indicates that the neck extensor muscle could be more elongated. A one-way repeated measures analysis of variance (ANOVA) and Bonferroni's post hoc test were used to determine the effects of stretching position on shear elastic modulus.
Results
ANOVA showed the main effect of stretching positions in all muscles. As a result of post hoc tests, in the shear elastic modulus of the trapezius muscle, F+LF+RR showed a significantly higher value than REST and LF. Three stretches, F+LF, F+LF+RR and F+LF+LR were significantly higher in the splenius capitis muscle than in REST, F and LF. Four stretches of LF, F+LF, F+LF+RR and F+LF+LR were significantly higher than REST and F in the levator scapulae muscles.
Discussion
The results of this study suggest that the stretching position with a combination of flexion, lateral bending and ipsilateral rotation may be effective for elongating the trapezius muscle. Furthermore, our findings suggest that the stretching position with a combination of flexion and lateral bending may have more effect on splenius capitis elongation and that the stretching position adding lateral bending may be effective for elongating the levator scapulae muscle.

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Contact
kou.yanase1991@gmail.com

EFFECTS OF 300 SECONDS OF STRETCHING ON FLEXIBILITY AND ISOMETRIC MUSCLE FORCE DO NOT DIFFER BETWEEN STRETCHING METHODS

MATSUO, S.1,2, SUZUKI, S.2, IWATA, M.1,2, TSUCHIDA, W.1, FUKAYA, T.2, YAMANAKA, E.2, ASAI, Y.1

1: NIHON FUKUSHI UNIV. (HANDA, JAPAN), 2: GRAD. SCH. MED., NAGOYA UNIV. (NAGOYA, JAPAN)

Introduction
Stretching is performed as a part of warm-up exercise. Previous studies have shown that static stretching increases range of motion (ROM) and passive torque at pain onset (PT), and decreases passive stiffness and muscle force (Matsuo et al., 2015). Dynamic stretching has been shown to improve muscle performance (Yamaguchi et al., 2014). The effects of combined static and dynamic stretching have recently been investigated (Wong et al., 2011), but it is still unclear which stretching method has the greatest effects on flexibility and muscle force. The aims of this study were to investigate the effects of static, dynamic, and combined stretching on flexibility and isometric muscle force.
Methods
In this randomized crossover trial, nine healthy young men undertook a total of 300 s of static, dynamic, and combined stretching (two combined stretching protocols: (1) 150-s static stretching followed by 150-s dynamic stretching and (2) 150-s dynamic stretching followed by 150-s static stretching) of their right knee flexors. The four stretching sessions were each performed on separate days. ROM, PT, passive stiffness, and maximum voluntary isometric knee-flexion force were measured using an isokinetic dynamometer immediately before and after each stretching session (Matsuo et al., 2015).
Results

All stretching methods significantly increased ROM and PT, and significantly decreased passive stiffness and maximum isometric force after stretching. There were no significant differences in the magnitudes of the changes in any measurements between stretching methods.
Discussion
Longer periods of static stretching have been shown to increase flexibility and decrease muscle performance more than shorter periods (Matsuo et al., 2013, Simic et al., 2013). In addition, a recent study suggested that excessive dynamic stretching might impair muscle performance (Yamaguchi et al., 2014). Our results suggest that 300-s of stretching is sufficient to increase flexibility and decrease isometric muscle force regardless of the stretching method.
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Contact
matsuo@n-fukushi.ac.jp

FEATURE OF TRUNK MUSCLE ACTIVITIES DURING SWIMMING IN SWIMMERS WITH LOW BACK PAIN

KITAMURA, G., TATEUCHI, H., MIZUKAMI, Y., TAMEZAWA, T., ICHIHASHI, N.

KYOTO UNIVERSITY

Introduction
Low back pain (LBP) often occurs in swimmer (Masiero S et al., 2008). Repetition of lumbar hyperextension during swimming may cause LBP (Wanivenhaus F et al., 2012). To prevent hyperextension, trunk muscle activities may be important. However, trunk muscle activities of swimmers with LBP during swimming are not clear. The aim of this study was to clarify the feature of trunk muscle activities in swimmers with LBP.
Methods
Of the 35 swimmers initially enrolled in this study, 11 swimmers (LBP group) had LBP (more than 30/100 in VAS scale) by lumbar hyperextension, 21 swimmers (control group) had no LBP for the past one year. Because 3 swimmers had LBP but not by lumbar hyperextension, they were excluded. To assess 5 muscle (rectus abdominis [RA], external oblique [EO], internal oblique-transversus abdominis [IO-TrA], lumbar erector spine [LES], lumbar multifidus [LMF]) activities, water proofed surface EMG was used. Subjects performed 15 m dolphin kick (DK) and 25 m crawl (Fr) with full effort and 3kicks for DK around 10 m and 2 right strokes for Fr around 15 m was analyzed. Videos in the sagittal plane were recorded. DK and Fr were divided into DK1 (hip flexion phase) and DK2 (hip extension phase), Fr1 (finger entering water to 90 degrees shoulder flexion), Fr2 (Fr1 end to finger leaving water) and Fr3 (Fr2 end to Fr1 start). Root mean square of EMG and mean of muscle activities of each phase was calculated. EMG signals was normalized to each muscle's maximum voluntary contraction. Muscle activation ratio (ratio) of IO-TrA and RA (IO-TrA/RA), IO-TrA and EO (IO-TrA/EO), IO-TrA and RA + EO (IO-TrA/[RA + EO]), LMF and LES (LMF/LES) was calculated. Age, height, body weight, BMI, athletic career, time of Fr, and EMG parameters were compared between two groups by Mann-whitney U-test.
Results
Because of EMG error, 2 controls were excluded and 30 data (LBP; 11: control; 19) were obtained There was no significant difference between the two groups in age, height, body weight, BMI, athletic career, time of Fr. LBP group showed significantly lower muscle activation of IO-TrA at DK2 (LBP; 25 ± 16 %: control; 58 ± 44 %), Fr1 (LBP; 54 ± 27 %: control; 94 ± 53 %), and lower ratio of IO-TrA/RA at Fr1 (LBP; 3.34 ± 2.54: control; 6.62 ± 5.63), IO-TrA/EO at DK1 (LBP; 1.01 ± 0.51: control; 1.92 ± 1.14), Fr1 (LBP; 1.02 ± 0.58: control; 2.08 ± 1.12), Fr3 (LBP; 1.22 ± 0.63: control; 2.64 ± 1.39), IO-TrA/(RA + EO) at Fr1 (LBP; 0.75 ± 0.45: control; 1.44 ± 0.70), at Fr3 (LBP; 0.93 ± 0.59: control; 1.80 ± 0.96).
Discussion
LBP group showed lower activity of IO-TrA and lower ratio of IO-TrA/RA, IO-TrA/EO, IO-TrA/(RA + EO) compared with the control group. IO and TrA contribute to spine stability, therefore lower activation of IO-TrA or alteration of ratio may cause spinal instability and LBP.
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EFFECTS OF WELL-ROUNDED EXERCISE TRAINING ON CARTILAGE METABOLISM IN FEMALES WITHOUT RADIOLOGICALLY KNEE OSTEOARTHRITIS

YASUDA, T.1,2, AZUKIZAWA, M.2, ITO, H.2, HAMAMOTO, Y.2, NAKATANI, T.3, TSUBOYAMA, T.2, MATSUDA, M.3, MATSUDA, S.2

1. KOBE CITY MEDICAL CENTER GENERAL HOSPITAL, 2. KYOTO UNIVERSITY GRADUATE SCHOOL OF MEDICINE, 3. TENRI UNIVERSITY

Introduction
The population with osteoarthritis (OA) is increasing due to the aging society. Maintenance of healthy cartilage is essential for prevention of osteoarthritis (OA). Physical exercise is highly recommended for OA patients because of evidence that it reduces pain and enhances physical function of joints with OA. For older adults, exercise prescription ideally includes aerobic, muscle strengthening, and flexibility exercises. However, effects of the exercise intervention on pre-osteoarthritic cartilage remain unclear. Purpose of the study: To evaluate the effects of well-rounded exercise training on cartilage metabolism using systemic biomarkers in females without radiologically knee OA.
Methods
A combination of aerobic, resistance (mainly for quadriceps and hamstrings), flexibility, and balance exercise trainings was assigned to 23 female subjects [mean age 57.9 (49 to 68), mean BMI 21.8 (18.6 to 24.7)] without radiologically knee OA (Kellgren-Lawrence grade ≤1) for 90 minutes once a week during 12 weeks under supervision. The subjects were followed up during the subsequent 12 weeks. Blood and urine samples were collected at 0, 1, 2, 4, 8, 12, 16, 20, and 24 weeks from the initiation of intervention. Whereas type II collagen carboxy-propeptide (CPII) and cartilage oligomeric matrix protein (COMP) were measured using serum by enzyme-linked immunosorbent

assay (ELISA), collagenase-generated neoepitope of type II collagen (C2C) and carboxy-telopeptide of type II collagen (CTX-II) were evaluated using urine by ELISA.
Results
One week after the initiation of the training, type II collage degradation evaluated by CTX-II dropped down to lower levels, and thereafter maintained the levels by the final follow-up. Compared with the baseline, a significant decrease in CTX-II levels was found at 1, 2, 4, 8, and 24 weeks. Similarly, type II collage cleavage evaluated by C2C reduced immediately after the exercise intervention, and reached the significantly low levels at 12, 20, and 24 weeks. Type II collagen synthesis evaluated by CPII and a cartilage degradation marker COMP had no appreciable changes during the whole period of intervention and the subsequent follow-up.
Conclusion
Well-rounded exercise training could decrease type II collagen degradation in females without radiologically knee OA.

CLINICAL EFFECT OF DEEP NECK BENDING EXERCISE APPLIED TO CHRONIC NECK PAIN PATIENTS

SEO, Y.H., WEE, Y.R., HAN, E.S.

CHOSUN UNIVERSITY

Introduction
Treatment for rehabilitation is to prevent injuries and illness at the onset of the disease, and to perform functional rehabilitation of the disorder. Although the original intention of exercising for health maintenance is desirable, it is possible to injure health and suffer various injuries by unreasonable physical activities without the prescription of a doctor or an expert. The purpose of this study was to investigate the effect of deep neck bending exercise on neck pain, neck disability index and anterior head posture in patients with chronic neck pain.
Methods
Twenty-eight patients with chronic neck pain were randomly selected and divided into an experimental group (N=14) applying deep neck bending exercise and a control group (N=14) applying only general neck strengthening exercise. And exercises three times a week for a total of four weeks. The subjects were measured before, after, and 8 weeks after cervical disability index, pain grade, and frontal head posture (head tilt angle, neck bend angle, anterior shoulder angle) by X-ray, and exercise effects were compared for each exercise group. Statistical analysis was performed by repeated measures analysis. Independent sample t-test was conducted to compare the difference of each rehabilitation exercise group. The significance level applied to the statistical program was .05.
Results
The results of this study showed that the cervical disability index, pain grade, anterior head posture (head tilt angle, neck bend angle, anterior shoulder angle) were significantly improved in the experimental group with deep neck bending exercise ($p < .05$).
Discussion
The deep neck bending exercise was found to be effective in the reduction of pain, functional recovery and correction of anterior head posture in patients with chronic neck pain, and suggests that it is used as a rehabilitation exercise for chronic neck pain patients.
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Contact
6091121@hanmail.net

RTD EVALUATION AS FUNCTIONAL REHABILITATION AND RTS CRITERIA FOR HAMSTRING STRAIN INJURIES. A PRELIMINARY STUDY.

BIKANDI, E.3, ETXALEKU, S.1,4, IZQUIERDO, M.2, ALFARO-ADRIÁN, J.1, SETUAIN, I.1,2.

1: TRAUMATOLOGÍA DEPORTIVA NAVARRA (PAMPLONA, SPAIN), 2: UNIVERSIDAD PÚBLICA DE NAVARRA (NAVARRA, SPAIN); 3: ATHLETIC CLUB DE BILBAO (BILBAO, SPAIN); 4: CENTRO DE ESTUDIOS, INVESTIGACIÓN Y MEDICINA DE

Introduction
Isokinetic assessment is described as a useful method for strength evaluation throughout the hamstring injury rehabilitation process. Rate of torque development (RTD) is derived from the force-time curves recorded during maximal voluntary contractions (Aagaard et al., 2002). This variable could check the neuromuscular system status in order to achieve the most optimal and accurate return to sport (RTS) condition. The objective of this study was to describe the knee flexion peak torque (PT) and RTD in athletes who sustained medial or lateral hamstring strain injury after fulfilling an objective criteria-based rehabilitation protocol.
Methods
13 track and field athletes (7 female and 6 male) who suffered a medial or lateral hamstring strain conducted a maximal voluntary isometric strength evaluation using an isokinetic device (HUMAC NORM Isokinetic Extremity System, CSMi, Stoughton, MA) at the end of the rehabilitation period as RTS criteria. The PT (N.m) and RTD (N.m/s during the first 200 ms) were recorded for both healthy and injured limbs at 15° (for lateral hamstring) and 90° (for medial hamstring) knee flexion angular position. RTD calculations were automatically processed with the implementation of a self customized program (Matlab v. 7.5.0.342 [R2007b] USA).
Results
Hamstrings PT did not differ between the injured and healthy limbs (mean SD 164,64 N 75,65 vs. 167,31 N 70,35 respectively [P=0,769]). Otherwise, a significant reduction was found in maximal RTD for the injured limb in comparison to the healthy limb (766,11 N.m/s 285,96 vs. 891,76 N.m/s 261,3 respectively [P=0,01]).
Discussion
The observed RTD reduction in hamstring strained limbs after completing the full rehabilitation process could constitute a lasting neuromechanical deficit, related to previously described risk factors for hamstring injury, such as neuromuscular inhibition (Fyfe et al., 2013). Despite the injured athletes achieved full muscle peak torque exertion capabilities, lasting neuromuscular impairments may persist on them when returning back to competition (Peñailillo et al., 2015). These results could be associated with hamstring re-injury occurrence (Marshall et al., 2014) being the main focus of a future investigation.
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LOWER LIMB ELECTROMYOGRAPHY IN PATIENTS WITH ACHILLES TENDON REPAIR DURING RAMP ANKLE ASCENDING AND DESCENDING EXERCISE

KUO, C.Y.1, WANG, H.K.1,2, CHEN, P.Y.2, YEH, W.L.3, SUNG, Y.L.4

1: COLLEGE OF MEDICINE, NATIONAL TAIWAN UNIVERSITY, 2: NATIONAL TAIWAN UNIVERSITY HOSPITAL, 3: CHANG GUNG MEMORIAL HOSPITAL, 4: COLLEGE OF ENGINEERING, NATIONAL TAIWAN UNIVERSITY

Introduction
Weakness in end-range plantar flexion after Achilles tendon repair is observed to occurred with functional impairments. Neuromuscular and biomechanical evidences have shown that neural control, muscle activation and mechanical properties are determinants of functional outcomes after Achilles rupture1,2. The aim of this study was to compare the surface electromyography of the calf (soleus, medial and lateral gastrocnemius) and tibialis anterior muscles, the Achilles tendon vibration frequency and the ground reaction force during ramp ankle ascending/descending movements in legs with and without a repaired Achilles tendon.
Methods
Subjects who had undergone a unilateral Achilles tendon repair at least three months ago but no more than twelve months were recruited. The subjects stood on a plywood box placed on a Kistler force plate and were instructed to do three cycles of maximal heel lifting (ascending) and lowering (descending) while keeping the knee straight and maintaining a one-legged standing and full weight-bearing position. A 2D motion analysis system was used to collect kinematic data. Myoelectrical activities of the calf and tibialis anterior muscles were measured by active-surface EMG-recording electrodes. Achilles tendon vibration frequencies were measured by a triple-axis accelerometer. Data was analysed using paired t tests with the alpha level set at 0.05.
Results
Nine subjects (7 males and 2 females) with an average age of 34 years old were recruited. The results showed that the median frequencies of the EMG in the tibialis anterior muscle during both the ascending and descending phases of the ankle movements were significantly lower in legs with a repaired Achilles tendon ($p=0.05$ and $p=0.024$ respectively).
Discussions
The results indicate that an Achilles tendon rupture may contribute to subsequent changes in muscle fibre properties or the recruitment patterns in the antagonist muscle during full-range cyclic stretch-shortening activities of the ankle. Full-range stretch-shortening exercises for both the ankle plantarflexor and dorsiflexor muscles should be conducted after an immobilization stage and within three months after the repair.
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Contact
Email: r05428012@ntu.edu.tw

USE OF WALKING POLES FOR POSTURAL STABILITY DURING STANDING IN PATIENTS WITH KNEE AND HIP OSTEOARTHRITIS

FUKUSAKI, C., LEETAWESUP, K., ISHII, N.

THE UNIVERSITY OF TOKYO

Introduction
Individuals with knee and hip osteoarthritis (OA) have difficulties with controlling postural stability (Giemza et al., 2007; Masui et al., 2006). This study aimed to investigate the effects of use of walking poles during standing on postural stability in these patients, and to compare the effects in a patient group with the results in healthy people of similar age.
Methods
Twelve elderly women with knee and hip OA and 11 healthy elderly women participated in this study. The centre of pressure (COP) was recorded for 30s using a force platform. Subjects were asked to stand as still as possible with feet together and eyes open, while looking straight ahead. Three tests were conducted in each subject with foot position unchanged: (1) standing with arms at the sides (normal standing, NS); (2) standing while lightly grasping two poles, with upper arms at the sides and elbows bent at right angles (pole-narrow position, PN); and (3) standing while lightly grasping two poles, with upper arms abducted at around 20 degrees and poles planted about 15 cm ahead of PN position (pole-wide position, PW). From the COP time series, mean velocity (MV), sway area (SA), MV in the medial-lateral (ML) and anterior-posterior (AP) directions, and standard deviation (SD) in the ML and AP directions were calculated. Indices in PN and PW were divided by those in NS to evaluate postural sway reduction with use of poles.
Results
All indices were significantly smaller in PN than in NS ; MV, MV in the ML and AP directions, and SD in the AP direction were significantly smaller in PW than in NS; SA, MV in the ML direction, and SD in the ML direction were significantly larger in PW than in PN in the patient group. In the healthy control group, MV, SA, MV in the ML and AP directions were smaller in PN and PW than in NS. SD in the AP direction was smaller in PW than in NS and PN. PN to NS and PW to NS ratios were not significantly different between groups for all indices.
Discussion
These results suggested that use of two poles improved postural stability during quiet standing in elderly OA patients and healthy elderly people. Rates of improvement in postural stability with use of poles were not different between groups; however, compared with results for PN, PW increased postural sway in OA patients, especially in the ML direction, and further decreased AP postural sway in healthy elderly people. Proper positioning of poles to improve postural stability can differ depending on individual health status.
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Contact
fukusaki@k.u-tokyo.ac.jp

RADIOGRAPHIC COMPARISON OF KNEE OSTEOARTHRITIS, PAIN AND FUNCTION BETWEEN EX-ELITE MALE TABLE TENNIS PLAYERS AND THEIR AGED MATCHED CONTROLS

MEGHDADI, N., RAJABI R., ALIZADEH M.H.
UNIVERSITY OF TEHRAN

Introduction
Table tennis involves adoption of the semi-flexed knee and asymmetrical torsional trunk movements creating rotational torques on the knee joint which may predispose players to osteoarthritis (OA) of the knee (Spector et al., 1996), (Hunter & Eckstein, 2009). This study aims to compare radiographic signs of knee OA and associated pain and functional levels in ex-elite male table tennis players and control subjects.
Methods
Study participants were 22 ex-elite male table tennis players with 10 years of involvement at the professional level and 22 non-athletic males recruited from the general population. A set of three radiographs taken from each knee were evaluated by an experienced radiologist using the Kellgren and Lawrence (KL) scale (0-4) to determine radiographic levels of OA severity. The intercondylar distance was taken as a measure of lower limb angulation. Participants also completed the pain, stiffness, and physical function categories of the WOMAC questionnaire.
Results
The results showed 78.3% of the ex-elite table tennis players and 36.3% of controls had varying signs of radiographic knee OA with a significant difference in the prevalence levels of definite radiographic OA (KL scale > 2) found between the two groups. Based on the WOMAC scores, 68.2% of the ex-elite table tennis players reported symptoms of knee pain compared with 27.3% of the controls though no significant differences were identified in the mean physical function or stiffness scores between the two groups. In terms of knee alignment, 73.7% of the ex-elite athletes and 32% of the control group had signs of altered lower limb alignment (genu-varum). Statistical differences were found in subjects categorized as having radiographic signs of OA and altered lower limb alignment.
Discussion
The combination of rapid acceleration, deceleration, jumping and landing movements seen in table tennis players (Cooper C et al.) are common to racket sports and also in elite athletes of other weight-bearing sports as a whole (Takeda H et al., 2011) and collectively the results of this study, serves to highlight the increased vulnerability of racket players to knee OA when playing at the professional or the elite level. Ex-elite table tennis players were found to have increased levels of radiological signs of OA in the knee joint though this did not transpire through to altered levels of physical disability or knee stiffness in these players when compared with subjects from the general population suggesting that function in these players is not severely impacted upon.
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Conventional Print Poster

CP-PM16 Females, elite athletes and vibration: mixed session

BASELINE CHARACTERISTICS OF WOMEN WHO COMPLETED OR NOT AN ENDURANCE TRAINING PROGRAM

GARNIER, S., JOFFROY, S., HEREDIA, C., JOANISSE, D.R., MAURIEGE, P.
UNIVERSITÉ PAUL SABATIER

Introduction
Long-term adherence to physical activity is a major public health challenge. Interval training (IT) was shown to reduce body weight, fat mass and to improve cardiometabolic health (Gillen and Gibala, 2014). However, controversies existed regarding the impact of IT vs. continuous training (CT) on the compliance of obese individuals to these programs. The main objective of this study was to compare physical and mental characteristics of women who completed or not the different training programs proposed.
Methods
Forty-nine healthy, sedentary and moderately obese (BMI=32±4 kg/m2) women (37±9 years) (mean±SD), were randomized to the IT (n=24) or CT (n=25) group. Both groups performed exercise 3 times a week, during 12 weeks. Each session of IT gradually increased from 6-10 x 1-min cycling at 75-85 % of heart rate reserve (HRR), and CT gradually increased from 20-35 min cycling at 50-60% HRR. Following measurements were performed: estimated VO2max (reflecting cardiorespiratory fitness, CRF) calculated from the 2-km walking test (Laukkanen et al., 1992), anthropometry using standardized procedures, body composition, perceived health estimated by the short perceived health questionnaire (SPHQ; Garnier et al. 2013), quality of life through the SF-36 (Ware and Gandek, 1998), and eating behaviors by the three-factor eating questionnaire (Stunkard et al., 1985). Baseline differences between subjects who completed or not the study were analyzed using a 2-way ANOVA. One-way ANOVA followed by Tukey-Kramer HSD post-hoc tests was used to locate between-group differences.
Results
At baseline, the two randomized groups showed similar characteristics except for the higher sleep quality (SHPQ) in CT than in IT participants ($p<0.005$). No significant differences were found between women who completed or not the CT program. In contrast, 'compliers' of the IT program (n=10) had lower height and higher lean mass ($p<0.05$), as well as a better mental component score (SF-36), perceived sleep quality, stress level and general health (SPHQ) than those who did not comply with this program (n=14) (0.005
Discussion
Taken together, these results suggest that participants with a low mental health and a high height should be guided towards CT rather than to IT, in order to increase their long-term adherence to physical activity. Further randomized controlled trials are required to confirm these preliminary findings and develop clinical guidelines in terms of obesity treatment more adapted to subject characteristics.
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THE EFFECT OF HIGH-INTENSITY TABATA EXERCISE ON THE MAXIMAL OXYGEN UPTAKE AND BLOOD VARIABLES OF MIDDLE-AGED WOMEN

YOON, S.M., SEO, H., SEO, Y.H.

CHOSUN UNIVERSITY

Introduction
The economic growth and the development of science and technology have changed the lifestyle of modern society, and modern people have decreased the amount of physical activity and the energy to be consumed has increased, and lifestyle diseases such as obesity are increasing. In particular, middle-aged women experience a negative physical change following an obesity or secondary cardiovascular and cerebrovascular disease due to an irregular menstrual cycle and an individual weight gain, over the age of 40 years. In this study, we aimed to prevent obesity and various diseases in middle aged women by activating Tabata exercise by increasing maximal oxygen intake and improving blood and delaying aging.
Methods
Subjects were selected from 26 middle-aged women who did not exercise regularly and did not have any special diseases. They performed Tabata exercise for 12 weeks for 3 times a week for 60 minutes a day. The subjects measured the maximum oxygen uptake and blood variables before and after the exercise to see the effects of exercise. Two-way repeated ANOVA was used for statistical analysis, and a corresponding sample and independent sample t-test were conducted when there was a significant difference. The statistical significance level of the results was .05.
Results
The results of this study showed that the maximum oxygen uptake was significantly different between the time * groups ($p < .001$). Blood variables showed significant differences between the time * groups in HDL-C and TG ($p < .001$), LDL-C was significantly different between the two groups ($p < .05$).
Discussion
Gobel (1980) reported that cardiovascular risk factors such as heart rate, blood lipid and blood pressure were decreased when the maximum oxygen uptake was increased by regular aerobic exercise. It was confirmed that the Tabata exercise is an effective exercise to improve the maximum oxygen uptake and blood variables in middle-aged women. Future research suggests that if we combine research on anti-aging, which is currently under the spotlight in a multifaceted perspective, we will be able to save the current medical expenses that enter the aging society and live a healthy life.
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Contact
soomi26@hanmail.net

ALTERATIONS TO SALIVARY IMMUNOGLOBULIN-A AND CORTISOL RESPONSES TO PROFESSIONAL RUGBY LEAGUE PRE-SEASON TRAINING

THORNTON, H.R.1, DELANEY, J.D.2, DUTHIE, G.M.3, DASCOMBE, B.J.1

1.SEMRC, LA TROBE UNIVERSITY, MELBOURNE, AUSTRALIA. 2.ISEAL, VICTORIA UNIVERSITY, MELBOURNE, AUSTRALIA. 3.SES, AUSTRALIAN CATHOLIC UNIVERSITY, STRATHFIELD, AUSTRALIA

Introduction
Professional teams manipulate training loads during the intensified pre-season period, as to maximise adaptations prior to competition. Salivary immunoglobulin-A (sIgA) and cortisol (sCort) concentrations are considered indicators of recovery status (McLean et al., 2010), and alterations in secretion may be associated with excessive fatigue and compromised immune function (Walsh et al., 2011). Therefore, monitoring within-week changes in these concentrations may provide useful information regarding the acute training status of team-sport athletes.
Methods
Saliva samples were collected from 14 professional rugby league players twice weekly (first and last training day) during six weeks of pre-season using the IPRO system. Concentrations of immunoglobulin-A (sIgA; µg/mL) and cortisol (nM) were determined, and the change between samples collected within the same week was determined. Total distance covered between the samples was measuring using GPS (GPSports, Canberra, Australia). Linear mixed models determined within-week changes in salivary responses and total distance, where differences were categorised using effect sizes (±90% CI) and an MBI network.
Results
For changes in sIgA, week two was likely greater than week one (ES = 0.67; ±0.48), week three was almost certainly lower than week one (ES = 1.70; ±0.81), week two was almost certainly higher than week three (ES = 1.55; ±0.74), and week two was almost certainly higher than week five (ES = 2.23; ±1.06). For sCort, change in week two was likely higher than week one (ES = 0.42; ±0.45), week three was likely lower than week two (ES = 0.42; ±0.46), and week four was likely lower than week two (ES = 0.48; ±0.45). Compared to week one, total distance was almost certainly greater during week two (ES = 1.26; ±0.60) and week three (ES = 1.13; ±0.47). Total distance was almost certainly higher during weeks four and five (ES = 1.06; ±0.47 and 1.56; ±0.75, respectively).
Discussion
The present study observed within-week fluctuations in both sIgA and sCort concentrations, suggesting that immune and endocrine responses are sensitive to acute changes in training loads. There was a large increase in sCort in week two, and a suppression of sIgA in week three, which both corresponded with weekly increases in total distance. Together, this suggests that sIgA and sCort are sensitive to increases in training volume, and therefore may be a tool for monitoring the training response within team-sport athletes.
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Contact
19088233@students.latrobe.edu.au

EFFECT OF ACUTE MODAFINIL INGESTION ON COGNITIVE AND PHYSICAL PERFORMANCE FOLLOWING MENTAL EXERTION

RATTRAY, B., MARTIN, K., HEWITT, A., COOPER, G., MCDONALD, W.
UNIVERSITY OF CANBERRA

Introduction
Military and emergency service personnel routinely undergo mental fatigue inducing tasks which can subsequently reduce performance, potentially placing safety at risk. Modafinil has been shown to improve physical (Jacobs & Bell, 2004) and cognitive performance (Buguet et al., 1995) in sleep-deprived individuals, but it is unknown if it can offset detriments in performance related to mental exertion. This study aims to investigate the effects of Modafinil on cognitive and physical performance after prolonged mental exertion.
Methods
Physically active participants participated in a double-blind randomised crossover design. Initial testing established VO2max and acted as a familiarisation to the intervention protocols. For the intervention, participants ingested either modafinil (MOD; 400 mg) or placebo (PLA), and then 90 min later, began the 90 min incongruent Stroop task. Cognitive performance was measured by accuracy and reaction time on AX-CPT tasks measured at baseline, after one hour and post Stroop task. Mood, task demand and motivation were assessed throughout the laboratory visit via psychological scales. Following the Stroop task and other measures, physical performance was assessed using a time to exhaustion (TTE) protocol at 85% VO2max on a cycle ergometer. Sleep was monitored using activity armbands for 24 h following each visit.
Results
Preliminary results suggest that the MOD did not influence cognitive performance, although participants reported decreased mental demand (MOD = 9.2 ± 4.9 vs. PLA = 13.6 ± 3.7 AU) compared to the PLA condition. There was a tendency for better physical performance with MOD ingestion (TTE; MOD = 10.5 ± 1.6 vs. PLA = 9.6 ± 1.6 min). Sleep time (MOD = 5.1 ± 0.8 vs. PLA = 8.1 ± 1.4 h) and efficiency (MOD = 60.2% ± 7.2 vs. PLA = 81.6% ± 7.7) were both significantly lower with MOD the night following the trial.
Discussion
Modafinil holds promise as a means of improving physical performance after a prolonged period of mental exertion. The psychostimulant may act, in part, through reducing the mental demand experienced during cognitive activity. There may be a cost to these benefits however, as sleep appears to be compromised following the MOD ingestion protocol utilised, which may impair subsequent cognitive and physical performance.
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Contact
ben.rattray@canberra.edu.au

THE RELATIONSHIP BETWEEN CENTRAL AND PERIPHERAL FATIGUE IN TERMS OF WITH OR WITHOUT SLEEP DEPRIVATION

SHIODA, K.1, SUGIMURA, H.2
1. KANAGAWA UNIVERSITY, 2. KOHOKU FAMILY CLINIC

Introduction
Sleep is important for recovery from peripheral and central fatigue. Although there have been many reports on the effect of sleep on recovery from fatigue, it is unclear that the relationship between central and peripheral fatigue in terms of sleep recovery. For assessment of fatigue, there were some methods in previous studies. The interpolated twitch technique (ITT) is widely used to assess voluntary activation (VA) of skeletal muscles (Merton, 1954). In addition, the reduction of VA in maximal efforts is the sign of central fatigue, and resting twitch (RT) is the sign of peripheral fatigue (Gandevia, 2001). The critical flicker fusion frequency (CFFF) test is useful for assessing the arousal level, and the value of CFFF decreases with fatigue (Curran et al., 1990). The purpose of this study, therefore, is to investigate the relationship between central and peripheral fatigue in terms of with or without sleep deprivation using CFFF, ITT.
Methods
Healthy young adults who did not have sleep problem were recruited. They participated in three experimental conditions in random order: sleep (0%: SL), partial sleep deprivation (50%: SD50) and total sleep deprivation (100%: SD) conditions. They performed isometric maximum voluntary contraction (MVC) of elbow flexor muscles for assessing VA using ITT before and after condition. In addition to ITT and CFFF, subjective fatigue and sleep index were measured using visual analogue scale.
Results and Discussion
There were significantly positive correlation between MVC and VA (SL: r = 0.508, SD50: r = 0.720), CFFF and RT (SL: r = 0.592, SD50: r = 0.543). However, there were no significant correlation between these variables in SD condition. In conclusion, the present study suggested that central fatigue has a positive correlation with peripheral fatigue in SL and SD50 condition.
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PAIN THRESHOLDS AFTER ROWING AT DIFFERENT INTENSITIES

KRÜGER, S., GOTTSCHLAG, M.T., HILBERG, T.

UNIVERSITY OF WUPPERTAL

Introduction
Excessive exercise may enhance the risk of pain (Trompeter et al. 2016, Yang et al. 2012), but recent studies have also shown that exercise is associated with an exercise-induced-hypoalgesia (EIH) (Naugle et al.2012). If EIH is also triggered by a very short bout of vigorous exercise, has not been examined yet. Thus, the aim of this study was to determine if both a continuous sub-maximal endurance rowing session and a high-intensity sprint rowing session lead to EIH.
Methods
50 healthy men aged 26±4 years (mean±sd) underwent in randomized order a 30-minute sub-maximal rowing session (heart rate: 141±4 / work load: 141±32 watts), a 350-metre high-intensity sprint rowing session (heart rate: 180±19 / 561±128 watts / time: 60.5±4.6 seconds) as well as a 30-minute control condition of resting within seven days. Pressure pain thresholds (PPT) in Newton [N] as indicator for the individual pain sensitivity were assessed at the sternum and the forehead as well as at both knee, ankle and elbow joints, pre and post each session. Data were analyzed with a 3 (session: 30-minute vs 350-metre vs rest) x 2 (time: pre vs post) x 8 (PPT of all landmarks) ANOVA.
Results
Analyses revealed a statistically significant main effect for the factor session x time ($p \leq 0.001$). Post-hoc tests showed significantly increased PPT at all landmarks following the 350-metre sprint sessions (e.g. PPT [N] pre/post (mean±sd): right knee: 55.2±25.4/61.8±29.6, $p \leq 0.001$; left knee: 55.2±22.6/65.2±27.9, $p \leq 0.001$). In contrast, no significant PPT alterations were observed after the sub-maximal (e.g. right knee: $p=0.603$; left knee: $p=0.634$) and the resting condition (e.g. right knee: $p=0.222$; left knee: $p=0.325$).
Discussion
The results of this study reveal for the first time that EIA is also triggered by a very short-term, vigorous rowing exercise, but not by a sub-maximal rowing session. These observations support the hypothesis of an existing dose-response mechanism in EIH which could be caused by an activation of the endogenous opioid system. Further studies are needed to clarify the exact dose-response mechanism as well as the impact of different exercise types on EIA. Hereafter, the potential of EIA could be sufficiently used in conditions of chronic pain.
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Contact
skrueger@uni-wuppertal.de

VARIABILITY SLIDING UPON A NOVEL SLIDE VIBRATION BOARD AT DIFFERENT VIBRATION FREQUENCIES

GISBERT, J.F.1, FERNÁNDEZ-VALDÉS, B.1, RODRÍGUEZ-JIMÉNEZ, S.1, MORAS, G.1

1: INEFC (INSTITUT NACIONAL D'EDUCACIÓ FÍSICA DE CATALUNYA)

Introduction
Slideboard (SB) exercise is a multifaceted, closed kinetic chain that imparts low-impact forces to the lower extremities and is used to enhance strength, endurance, proprioception, agility, balance body composition, and cardiorespiratory fitness (Diener et al. 1994, Weber et al. 1998). This study aimed to assess the effect of different vibration frequencies on trunk acceleration while sliding upon a novel slide vibration board (SVB) using Approximate Entropy (ApEn) (Pincus 1991).
Methods
6 amateur skaters (2 males and 4 females; mean ± SD: age 24.9 ± 6.9 years, height 1.72 ± 0.13 m, weight 67.6 ± 27.4 kg) participated in this study. The study was conducted on a 1,80m SVB (Patent, P201630075). Trunk acceleration of the subjects under different vibration conditions was measured using an inertial measurement unit (WIMU, Realtrack Systems, Almeria, Spain). The study was carried out on three days: on the first day, subjects underwent a familiarization session. On the second day, the exercise rhythm for each subject were obtained and controlled using a metronome. On the third, subjects performed 1 set of 30 s in the following vibration conditions (no vibration (0), 20, 25, 30 and 35 Hz) at random.
Results
No mean acceleration differences were found between vibration conditions. Significant differences in ApEn were found between 0Hz and 20 ($p = 0.001$), 25 ($p < 0.001$), 30 ($p < 0.001$) and 35 Hz ($p = 0.001$).
Discussion
The ApEn values increase linearly with increasing frequency. Sliding on a SVB from 20 to 35 Hz may be considered as a practical alternative to constrain the athlete than sliding without the vibration stimulus.
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Contact
gisbertorozcopep@gmail.com

EFFECTS OF VIBROTACTILE FEEDBACK ON SEDENTARY BEHAVIORS OF ADULTS: A PILOT RANDOMIZED CONTROLLED TRIAL

NISHIMURA, M.1, SASAI, H.1,2, NAKATA, Y.1, MAEDA, S.1

1: UNIVERSITY OF TSUKUBA (IBARAKI, JAPAN), 2: JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE (TOKYO, JAPAN)

Introduction
Despite detrimental associations of prolonged sitting with various health outcomes, no effective intervention strategies to reduce sedentary behavior have been established yet. The purpose of this pilot trial was to determine whether immediate vibrotactile feedback using a thigh-worn activity monitor can reduce sedentary behavior of adults.
Methods
This 8-week pilot randomized controlled trial enrolled 26 adults aged 30–69 years who reported a sedentary time of ≥ 8 h/day, through advertisements in local newspapers. They were randomly assigned to either a control (CON, n = 13) or vibrotactile group (VIB, n = 13). All the participants wore activPAL3VT (PAL Technologies, UK) on their thigh for 9 h, from 9:00 a.m. to 6:00 p.m., for 7 consecutive days at baseline (week 0), during the intervention (weeks 1, 3, 5, and 7), and after the intervention (week 8). During the intervention period, the participants in the VIB group received a weekly printed report on their recent sedentary patterns and immediate vibration feedback on the thigh monitor when their continuous sedentary time reached ≥ 30 min. The participants in the CON group did not receive any feedback. The primary outcome was change in total sedentary time from baseline to the intervention period (averaged across weeks 1 to 7). Secondary outcomes included changes in time spent in standing and stepping, and the number of sit-to-stand transitions assessed by using activPAL3VT. This trial was registered in the UMIN Clinical Trials Registry (UMIN000024372).
Results All 26 participants completed the 8-week intervention. No significant between-group difference in the change in total sedentary time was found (CON: −3.0 ± 4.3 min/h, VIB: −1.3 ± 3.4 min/h; p = 0.27). Likewise, no significant differences were observed in the changes in time spent in standing (CON: 2.2 ± 2.8 min/h, VIB: 0.9 ± 2.4 min/h; p = 0.23) and stepping (CON: 0.9 ± 1.9 min/h, VIB: 0.4 ± 1.2 min/h; p = 0.47), and the number of sit-to-stand transitions (CON: 0.1 ± 0.9 times/h, VIB: 0.1 ± 0.7 times/h; p = 0.88). A significant reduction in total sedentary time was observed when data from the two groups were pooled together (mean: −2.2, 95% confidence interval: −3.8 to −0.6).
Discussion
This study suggests that the vibrotactile feedback program does not offer any advantages over the non-feedback control in reducing sedentary behavior. The reduction in sedentary time observed in the entire population indicates that wearing the device per se might have motivated the participants to reduce their sedentary behaviors irrespective of their group assignment.

Conventional Print Poster

CP-PM17 Ventilation, hypoxia, health and fitness

MEASUREING THE ENERGY OF VENTILAION AND CIRCULATION DURING HUMAN WALKING USING INDUCED HYPOXIA

HORIUCHI, M., FUKUOKA, Y., HANDA, Y., ABE, D., PONTZER, H.

MT. FUJI RESEARCH INSTITUTE

Introduction
Humans' bipedal walking gait is a defining feature of our lineage, and the metabolic costs of walking have figured prominently in discussions of human evolution and ecology (Pontzer et al., 2014). Most analyses of walking energy costs have focused on the cost to move and support the body, while the costs of cardiopulmonary work have been ignored. To determine the contribution of respiration and circulation to total walking cost, we measured energy expenditure, EE (J s-1) during walking under three oxygen concentrations.
Methods
Eleven healthy, young, males walked on a treadmill at seven gait speeds (0.67–1.83 m s-1) on a level gradient under normoxia (N; 21% O2), moderate (M; 15% O2) and severe hypoxia (S; 11% O2). EE was calculated using pulmonary oxygen uptake and carbon dioxide output. To determine respiration and circulation cost, the hypoxia-induced elevation in heart rate (HR [bpm]), and ventilation (VE [L min-1]) were calculated at each speed and condition and compared to the the change in EE. Changes in EE, VE and HR between S and N conditions, and between M and N were correlated to determine the effect of increased cardiopulmonary work on EE.
Results
With the intercept set at 0, EE increased with ventilatory effort as $\Delta EE = 1.10\ \Delta VE$ ($r^2=0.84$, $p<0.001$), and with circulation as $\Delta EE = 0.36\ \Delta HR$ ($r^2=0.81$, $p<0.001$). In a multivariate model combining HR and VE, respiratory costs were 0.44 W per each L min-1 increase in VE, and circulatory costs were 0.24 W per each bpm increase in HR (model adjusted $r^2=0.97$, $p<0.001$). Cardiopulmonary costs (VE and HR) accounted for 23% of resting EE, but less than 5% of net walking costs (i.e., with resting EE subtracted).
Discussion
Measuring cardiopulmonary costs induced by hypoxia, as done here, enabled us to measure the energy expenditure of the heart non-invasively. The small contribution of cardiopulmonary effort to net walking cost is in line with previous work in humans and a range of other vertebrates (Markley & Carrie, 2010). These results lend support to analyses of locomotor cost that focus on musculoskeletal energy expenditure, ignoring cardiopulmonary work (Sockol et al., 2007). The relative low cardiopulmonary costs even under severe hypoxia (less than 8%) suggests that the primary cost of walking at altitude remains the musculoskeletal effort needed to support and propel the body.
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Contact
mhoriuchi@mfri.pref.yamanashi.jp

THE RELATIONSHIP BETWEEN LUNG FUNCTION AND PHYSICAL FITNESS PARAMETERS

IMAI, T.1., WATANABE ,K.2.

AICHI INSTITUTE OF TECHNOLOGY 1,UNIVERSITY OF TSUKUBA 2

Introduction
Several large cohort studies have reported an association between poor with low lung function and the risk of cardiovascular disease. However, these prior studies were designed older or the middle- aged individuals. In addition, little is known about the relation between physical fitness parameters (e.g., endurance ability, muscular strength, and agility) and lung function. The purpose of this study was to investigate the relation between lung function and physical fitness parameters in university students.
Methods
A total of 84 university students participated in this study. Forced vital capacity (FVC), forced expiratory volume 1.0 (FEV1.0), FEV1.0/FVC, and peak expiratory flow（PEF） were determined using a spirometer. Physical fitness were evaluated by the physical fitness test of the Ministry of Education, Culture, Sports, Science and Technology in Japan; the exercises measured included grip strength, sit up, sit and reach, side step, meter shuttle run (Run) and standing long jump (Jump). Pearson product moment correlations were used to determine the linear relationships among selected dependent variables ($P < 0.05$)
Results
We analyzed the results from 51 subjects. Subjects excluded from the investigation included: those with an FEV1.0/FVC <80% of predicted, and those who did not participate in the physical fitness or respiratory function tests. FVC and FEV1.0 were significantly correlated with grip strength (correlation coefficient, r = 0.65 and 0.68, respectively), sit up (r = 0.34 and 0.34), side step (r = 0.33 and 0.28), Run (r = 0.47 and 0.51), and Jump (r = 0.48 and 0.55). PEF significantly correlated with grip strength (r = 0.56), Run (r = 0.33), and Jump (r = 0.46). FVC1.0 significantly correlated only with sit and reach (r = –0.3).
Discussion
FVC and FEV1.0 were associated with five parameters included in the physical fitness tests performed in this study; grip strength was particularly strongly correlated. Previous studies have reported that FEV1.0 in middle-aged subjects is a marker for cardiovascular disease independent of age, sex, and smoking history. Low physical strength may increase the potential risk of cardiovascular disease. Physical fitness tests were associated with lung function in young individuals. As a consequence, grip strength may be a reliable marker of lung function.
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EFFECTS OF VOLUNTARY DIAPHRAGMATIC BREATHING ON NATURALLY INDUCED STRESS DURING A HIKING TOUR: A PILOT STUDY

KALDEWEY, K., SANDER, D., KRUSCHE, T., MOSER, D., PLATEN P.

RUHR-UNIVERSITÄT BOCHUM / FACULTY OF SPORTS SCIENCE

Introduction
Periods of extensive hiking may elicit a severe physiological stress response via strenuous activity, altered circadian rhythm, sleep quality and dietary regimen. Studies indicate that stress causes an impaired performance in executive functions, which leads to a compromised ability of decision making [1]. Latter factor is potentially crucial in the field of outdoor-hiking. Further, data depicted that heart rate variability (HRV) might reflect physiological stress based on measuring sympatho-vagal activity [2]. Paced diaphragmatic breathing patterns (DBP) have shown to enhance HRV [3]. The purpose of this study was to examine the effect of DBP on physical stress development during a strenuous hiking tour.
Methods
A group of 13 sport students (age=22±3 yrs) went on an extensive hiking tour over 10 days (d1-d10). The group was randomly divided into a control group (CG, n=6) and an experimental group (EG, n=7), which performed DBP for 9min/day during d1-d10. Salivary cortisol levels (COR) and HRV-markers (SDNN, RMSSD, PNN50, HF/LF) were measured shortly after awakening on d0-d10. Pre- and post-testing occurred on d-1/d+1 (72h adjacent to intervention). Values are presented as median and interquartile range.
Results
COR increased for the whole group during intervention (d0=15.45 [14.42 – 20.71], d3=27.91 [25.08 – 30.78], nmol/l; p=<.05). There was no correlation between COR and HRV-markers. Also no difference in SDNN and RMSSD to baseline was found for each group. Delta values show different intragroup developments for LF/HF (EG: d1=-0.47 [-2.19 - -0.37], d2=+0.94 [0.12 - 3.61], d5=-0.34 [-3.76 - -0.21], d+1=-0.62 [-2.57 - -0.43]; CG: d4=+3.28 [2.07 - 4.65], d6=+1.36 [1.10 - 4.83], d7=+3.77 [0.90 – 10.30], d8=+1.52 [1.02 - 7.21], p=<.05, respectively) and PNN50 (EG: d6=+68 [28 - 177], d+1=+10 [3 - 15]; CG: d2=-12 [-29 - -5], d3=-10 [-29 - -5], d4=-21 [-36 - -6], d6=+48 [37 - 59], d8=-12 [-31 - -1], p=<.05, respectively).
Discussion
Decisively increasing COR levels indicate a considerable physiological stress response for the whole group during the hiking tour. Moreover, HRV-data did not reflect COR increase adequately. However, DBP seems to have an effect regarding the trend of COR, PNN50 and LF/HF over time, which implies a blunted stress response and an enhanced parasympathetic activity in EG [2]. We recommend to further explore the validity and frame of sensitivity of HRV parameters in that context.
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THE EFFECTS OF ELASTIC BAND EXERCISE ON RESPIRATORY MUSCLE STRENGTH AND FUNCTIONAL CAPACITY IN THORACOTOMY PATIENTS

ERDOGAN, M., GUVENC, A., ERDOGAN, A., CERTEL, Z.

AKDENIZ UNIVERSITY

Introduction

Elastic band exercise is recognized as an inexpensive, safe and effective method to enhance physical performance in athletes (Jensen et al., 2014) and older individuals (Oesen et al., 2015). It is also frequently used for therapeutic training (Kim et al., 2012; Kim et al., 2015). However, there is no study to evaluate the effectiveness of elastic chest band exercise in pulmonary rehabilitation programs for post-thoracotomy patients. Therefore, the aim of this study was to examine the effects of an 8-week elastic chest band exercise program on respiratory muscle strength and functional capacity in thoracotomy patients.
Methods
In this study, 67 patients undergoing lung resection were randomly assigned into an experimental (n=36) or a control group (n=31). Patients in both groups followed a regular postoperative pulmonary rehabilitation program, while the experimental group additionally followed an elastic chest band exercise program for 8 weeks. Respiratory muscle strength was assessed using maximum inspiratory and expiratory mouth pressures (MIP, MEP) on seven different times. Respiratory functions (FEV1, FVC, FEV1/FVC) were measured by spirometry on six different times. Functional capacity was evaluated by 6-min walk test on four different times and health related quality of life was assessed with the SF-36 questionnaire on three different times before and after surgery.
Results
Although respiratory muscle strength and respiratory functions of the experimental and control groups decreased significantly immediately after the surgery when compared to preoperative values ($p<0.05$), these parameters improved in both groups at other postoperative periods. The increment of respiratory muscle strength, respiratory functions and functional capacity were higher in the experimental group than in the control group, especially at 4, and 8 weeks after surgery. Moreover, most of the health related quality of life measures were also higher in the experimental group than in the control group at 8 weeks after surgery.
Discussion
The results of this study are in line with the other studies demonstrating the beneficial effect of elastic band exercise on muscle strength and functional capacity in older population and patients (Kim et al., 2012; Oesen et al., 2015; Kim et al., 2015). Consequently, the use of elastic band exercise as a part of regular pulmonary rehabilitation program following thoracotomy is recommended.
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Contact
mukerremerdogan@akdeniz.edu.tr

ACUTE EFFECTS OF NORMOBARIC HYPOXIA ON DUAL-TASK GAIT VARIABILITY

BRENNICKE, M.,BEHRENDT, T., TÖRPEL, A., HAMACHER, D., SCHEGA, L.

OTTO-VON-GUERICKE UNIVERSITÄT MAGDEBURG

Introduction
Hiking at high altitude is a well-liked outdoor activity. Due to lower cerebral oxygenation, hypoxic conditions diminish motor performance and cognitive functions, especially when the motor task and the cognitive task are conducted simultaneously. Those motor-cognitive dual tasks are coordinated by executive functions and are associated with a greater expenditure of mental resources of the prefrontal cortex (PFC). Hypoxia does further increase PFC activity provoking a reduced capability of efficient resource utilisation (Davranche et al. 2016). Hypoxic conditions might evoke that the capacity of the limited mental resources of a dual task will be reached at an earlier stage of task complexity. We aimed to examine whether a cognitive task would increase gait variability (which is associated with decreased motor control) to a higher extent under hypoxic as compared to normoxic conditions.
Methods
18 young subjects walked for 5 minutes with and without a cognitive dual task under normoxic and hypoxic conditions (FiO2: 20.9% vs. 14.5%). With inertial sensors, kinematic time series were collected and the variability of stride times was calculated. A two-way ANOVA with repeated measurements was performed to compare single-task walking with dual-task under both environmental conditions.
Results
We observed an interaction effect ($F1,34=6.178$; $p=.018$; $\eta2=0.154$) indicating that there was a greater increase in gait variability provoked by the dual task in hypoxic conditions as compared to normoxic conditions. Post hoc analyses revealed a significant difference of dual-task walking variability under hypoxia ($p<.000$) but not in normoxia ($p=.487$). Only in the hypoxic condition, there was a significant difference between normal walking and dual-task walking ($p=.044$).
Discussion
Our data suggest that hypoxia might decrease the ability of performing a motor-cognitive dual task. Studies determined effects of hypoxia and gait (Drum et al., 2016) as well as hypoxia and cognitive tasks (Davranche et al., 2016), but those did not find any meaningful performance decrements. A suitable reason for the increased dual-task gait variability in our study might be the severity of our chosen dual task (Serial 7s and walking) in combination with the relatively high level of hypoxia (FiO2: 14.5%). We speculate that performing a dual-task under hypoxic conditions requires more resources than under normoxia. Future research should examine PFC activity while dual-task walking under hypoxia in order to analyse the haemodynamic responses of the brain.
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Contact
marie.brennicke@st.ovgu.de

MORPHOLOGICAL CHANGES OF MUSCLE AND MOTOR END PLATE DURING RECOVERY FROM MUSCLE ATROPHY

NISHIZAWA , T.

SIGAKKAN JUNIOR UNIVERSITY

Introduction
Although skeletal muscles are significantly affected by inactivity, these changes are reversible and they recover functionally when the muscles are made to work again. Muscle activity also simultaneously restores the function of motor cells which govern skeletal muscle. This suggests that the contractive activities of muscles is not only output to the exterior from the nerves, but is also necessary to maintain

neuromuscular function. In order to clarify this, we performed the cast immobilization to rats, was studied the effect of inactivity on the neuromuscular junction, moter endplate skeletal muscle.
Purpose
This research aims to study the morphological changes of muscle and motor end plate during recovery from muscle atrophy associated with cast fixation.
Methods
Male SD rats (9 weeks old) were subjected to cast immobilization of hindlimbs for 9days (IMM), followed by 7 days of the recovery period. Before the recovery period, rats were divided into two groups. One group (IMR) was allowed to the normal cage activity, another group (IMC) was administrated clenbuterol (1mg / kg / day) in addition to normal activity. After the experiment completed, the muscle was frozen and cut 50μm longitudinal section to conduct ChE staining and acetylcholinesterase AchE staining. The morphological observation of NMJs by optical microscope In NMJ forms, we measured the followings: Measurements using Olympus image processing system. Measurements items are muscle fiber diameter (FD), motor endplate length(LEL), motor endplate area (EpA), nerve terminals area (NTA) .
Results
In this study, due to the cast immobilization,the muscle was observed to atrophy for 1 week. On the other hand, the necrosis of myofibers was not observed. FD decreased for IM group and IMR group compared with C group. The IMC group was observed to recover up to 80%. Motor end plate size for the muscle fibers diameter increased significantly only in the IMR group. There is a certain ratio-relation between the muscle fibers diameter and the motor end plate. It was suggested that when there is abnormality in the muscle fibers, such ratio increases. After removing the cast, in the recovery process from atrophy, the motor end plate size increased prior to muscle fibers hypertrophy. It has been suggested that the LEL for the FD, there is a constant ratio relationship, when there is an abnormality in the muscle fibers is the ratio changes increase.In the recovery process , ELE and EpA have increased ahead of muscle fiber hypertrophy.
Discussion
As the myofibers atrophied, the motor end plate atrophied as well. After removing the cast, during the process from atrophy to recovery, the motor end plate size increased and then the muscle fiber diameter recovered.It is considered that In the recovery process from the atrophy, muscle hypertrophy have a control mechanism that occurs in association with the morphological changes of the nerve endings and the endplate.

WORKPLACE HEALTH PROMOTION FOR PUBLIC TRANSPORTATION SERVICE EMPLOYEES

WILKE, C., WALLMEROTH, N., BIALLAS, B.

GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Due to social and economic changes as well as the increase of work intensification and workload on transportation service employees, the companies need to develop measures in order to support the employees' health. A key element is the reduction of physical, psychological and social strains on employees to positively influence the high absence rates and frequency of inability to work within the public transportation industry (Aust, 2002; Resch, 2015).
Thus, the main objective of this study is to create a concept of workplace health promotion for public transportation service employees, based on the results of an analysis of needs and current research literature.
Methods
The analysis of needs identifies stresses and strains of three bus drivers and four rail riders of a local public transportation company. Seven theory-based, semi-structured and problem-centered expert interviews were conducted within a qualitative research design. The interviews were evaluated using the method of qualitative content analysis and MAXQDA Software (Verbi GmbH, Berlin). Further, two behavioural observations within the workplace analysis were carried out to uncover additional occupational strains through external assessment.
Results
The results show the existence of multi-sided physical and psychological strains which cause additional physical complaints. Among leg issues and shoulder discomforts, back pain is the most mentioned complaint of the respondents. The main causes mentioned for all physical discomforts are the steady sedentary position as well as the condition and adjustability of the driver seats. Furthermore, findings reveal that psychological aspects are subjectively more stressing than physical strains. Psychological strain is caused by shift work, the increase of conflicts within customer contact and the increasing work load (e.g. time pressure). The psycho-mental and psychosocial aspects represent the majority among all types of strains.
Discussion
The analysis of needs highlights the demand for both behavior-oriented and environmental-oriented health promoting measures. Findings are consistent with current research, which confirms the frequent occurrence of musculoskeletal disorders in public transportation service employees (Brütting et al., 2012).
Based on the presented results and current research literature, this study conceives a concept of workplace health promotion for public transportation services. This concept includes specific recommendations for responsible stakeholders. The implementation enables a target-group oriented workplace health promotion.
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Contact
wilke@dshs-koeln.de

EFFECT OF WATER INTAKE ON OWNERS WALKING THEIR DOG IN A HOT ENVIRONMENT

FURUMOTO, K.1, FURUKAWA, N.1, WAKABAYASHI, S.1, KUMAI, M.1, KURAHASHI, M.1, KAGAMI, R.1, NISHIBUCHI, K.1, YAMAGUCHI, H.2, KANDA, T.1, ITOI, T.1, ONODERA, S.3

1 KURASHIKI UNIVERSITY OF SCIENCE AND THE ARTS, 2 KIBI INTERNATIONAL UNIVERSITY, 3 KAWASAKI UNIVERSITY OF MEDICAL WELFARE

Introduction
Walking a dog is a physical activity that involves both the owner and the dog. In Japan, when comparing people who own dogs, people who do not own pets, and people who own pets other than dogs, dog owners have been reported to do more physical activities and

walking. However, attention should be given to the risk of occurrence of heat stroke while walking a dog during summer. The objective of this study was to support safe health promotion by preventing the occurrence of heat stroke when walking a dog. In this study, we examined the effect of water intake on owners walking their dog in a hot environment.
Methods
Eight healthy young male pet owners (age, 22.2±0.5 y; weight, 74.43±21.15 kg; height, 171.35±5.83 cm) walked with aged dogs. Rectal temperature, heart rate, number of steps, walking time, body weight loss, rating of perceived exertion (RPE), rating of thermal sensation (RTS), amount of water intake, amount of perspiration, and subjective sense of thirst (SST) were measured in all the subjects. The temperature of electrolyte sports drink was 15°C, and two conditions of drinking water intake were used (before and after walking and only after walking). Drinking and resting before and after walking were carried out in a room at 27°C.
Results
The owners walked their dogs at a temperature of 30.1±1.86°C, humidity of 55.57±8.31%, and wet-bulb globe temperature of 27.21°C±1.47°C. No significant differences were observed in the number of steps, walking time, heart rate, percent heart rate reserve (%HRR), and RPE. No significant differences were also observed in RTS, amount of perspiration, rate of body water loss, and SST. However, the total amounts of drinking water intake were higher ($p<0.05$) with drinking water before and after walking. With drinking water before and after walking, the rectal temperature immediately after walking was higher ($p<0.05$) than just before walking and at 30 min of rest after walking. With drinking water only after walking, the rectal temperature immediately after walking was higher ($p<0.05$) than at 30 min of rest after walking. The rectal temperatures just before walking, immediately after walking, and at 5, 10, and 15 min of rest after walking were lower ($p<0.05$) with drinking water before and after walking.
Discussion
The presence or absence of drinking water before walking a dog did not affect the amount and strength of physical activity. Walking an aged dog was a low-intensity physical activity for young owners. Rectal temperature, which is thought to increase by walking in a hot environment, was reduced by drinking a cold electrolyte sports drink after walking and by sitting and resting in a room at 27°C. Drinking water before walking a dog in a hot environment may suppress the decrease in circulating blood volume and reduce the increase in rectal temperature caused by walking in a hot environment.

Conventional Print Poster

CP-PM18 Brain and cognition

DOES CEREBRAL BLOOD FLOW AND OXYGENATION AFFECT IMPAIRMENT IN COGNITIVE FUNCTION DURING EXERCISE?

KOMIYAMA, T.1, TANOUE, Y.1, SUDO, M.2, UEHARA, Y.1, TANAKA, H.1, HIGAKI, Y.1, ANDO, S.3
FUKUOKA UNIVERSITY

Introduction
Intense exercise elicits highly metabolic demand. However, although metabolic demand increases during intense exercise, cerebral blood flow (CBF) and cerebral oxygenation decreases (Ide et al., 2009). Hence, oxygen delivery for brain may not meet to metabolic demand during intense exercise. Given that brain neuronal activity needs adequate oxygen delivery, decrease in CBF and cerebral oxygenation may impair cognitive function during intense exercise. The purpose of this study was to clarify whether decrease in CBF and/or oxygenation impair cognitive function during intense exercise.
Methods
Subjects completed cognitive tasks at rest and during exercise (exercise group; EX, n=15) or continuously rest (no exercise group; NE, n=7). Exercise intensities corresponded to 50% (moderate) and 80% (intense) of peak V(・)O2, and exercise duration were 7 min, respectively. The cognitive tasks consisted of Spatial Delayed Response task and GO/NOGO task, which required executive function. Cognitive function was evaluated by accuracy rate and reaction time of the GO/NOGO tasks. Middle cerebral artery mean velocity (MCA Vmean) and cerebral oxygenation were monitored continuously.
Results
In NE, cognitive function, MCA Vmean, cerebral oxygenation were not changed throughout the experiment (all Ps > 0.14). In EX, accuracy of the cognitive task was significantly impaired during intense exercise as compared with rest and moderate exercise (rest: $P < 0.05$, moderate $P < 0.01$). In contrast, reaction time in the cognitive task was not changed during intense exercise ($P = 0.31$). MCA Vmean significantly increased during moderate exercise compared with rest ($P = 0.01$). However, it significantly decreased during intense exercise compared with moderate exercise ($P = 0.01$). Cerebral oxygenation tended to decrease during intense exercise relative to rest ($P = 0.058$).
Discussion
A previous study suggested that change in CBF does not relate to improvement cognitive function during exercise (Ogoh et al., 2014). However, in the present study, intense exercise impaired cognitive function, and the impairment were accompanied by decreased CBF and oxygenation. Hence, impairments in cognitive function may be associated with decrease in CBF and oxygenation during intense exercise. We conclude that decrease in CBF and oxygenation potentially impair cognitive function during intense exercise.
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Contact
mt.komi51@gmail.com

IMPACT OF COGNITIVE AND COORDINATIVE INTERVENTIONS ON PAIN PROCESSING IN YOUNG HEALTHY MEN

HERZIG, M., KRÜGER, S., NOCKEMANN, K., HILBERG, T.
UNIVERSITY OF WUPPERTAL

Introduction
Acute and chronic pain cause limitations in physical and cognitive (COG) performance. In contrast, physical as well as COG activities also lead to alterations in pain processing [1,2]. In the field of chronic pain, endurance as well as strength exercises were used as pain reliev-

ing interventions [3]. The aim of this study was to examine if coordinative (COO) as well as COG interventions in this setting may lead to alterations in pain processing.
Methods
In a randomised crossover design, 30 healthy men (mean age 27 years) were measured before and after 3 different 45-minute interventions (COO; COG; rest (R) as control intervention) within 7 days by Quantitative Sensory Testing (QST). The QST is a validated instrument to assess the function of the somatosensory system by applying various thermal and mechanical stimuli. A total of 13 measurement parameters, including detection and pain thresholds, were determined at the dorsum of one foot. While the COO intervention includes standardized exercises to improve coordinative skills, the COG intervention consists of the Stroop-Test, the Perceptual Vigilance Task as well as the Automated Operation Span Task.
Results
The analysis of the QST-data in respect of the factors group (COO; COG; R) *time (pre; post) *stimuli (QST-parameters) revealed no significant main effects, neither for the factor group*time (p=0.76) nor for the factor group*time*stimuli (p=0.77). Thus, all stimuli remained constant in all groups from pre to post (e.g. mean±sd - heat pain threshold pre/post in C°: COO: 44.8±0.54/44.8±0.52; COG: 45.3±0.42/45.3±0.47; R: 45.5±0.55/45.1±0.53).
Discussion
In this setting, single COO and COG interventions had no effect on pain processing in young healthy men. Further studies have to clarify if longitudinal COO and COG interventions may lead to pain related alterations. In addition, it has to be examined how these interventions affect chronic pain states characterized by alterations in pain processing.
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Contact
m.herzig-hk@uni-wuppertal.de

EFFECT OF ESTRADIOL/PROGESTERONE RATIO ON COGNITIVE FUNCTION AT REST AND DURING EXERCISE IN HEALTHY YOUNG WOMEN

SAWAI, A., AKAZAWA, N., TANAHASHI, K., RA, S.G., MESAKI, N., MAEDA, S.
UNIVERSITY OF TSUKUBA, FUKUOKA UNIVERSITY

Introduction
Imbalance of sex hormone, estradiol and progesterone, causes premenstrual syndrome (PMS) and premenstrual dysphoric disorder (PMDD) in young women (Backstrom T. et al, 1974). Several studies showed that estradiol and progesterone involve in an improvement of the cognitive functions. However, the effect of estradiol-progesterone balance (estradiol/progesterone ratio) on cognitive functions at rest and during exercise remains unclear. Therefore, we investigated whether estradiol/progesterone ratio affects the cognitive functions at rest and during exercise in healthy young women.
Methods
Subjects were healthy young women (n=22), who had a normal menstrual cycle (day 25-38). The menstrual cycle was classified by measurements of serum estradiol and progesterone concentrations and basal body temperature into two phases: menstruation (day 1-5) and the luteal phase (3-10 days later of the ovulation). Serum estradiol and progesterone concentrations were measured using CLEIA technique. In luteal phase, the cognitive functions at rest and during exercise (30% and 70% Heart Rate Reserve (HRR)) were measured. The cognitive function evaluated the reaction time to a problem using the Stroop test, which was consisted by two difficulty levels (Samuel J.E.L. et al, 2012).
Results
Serum estradiol and progesterone concentrations significantly increased in a luteal phase. At rest, there was a positive correlation between reaction time and estradiol/progesterone ratio in a luteal phase ($r = 0.572$, $P < 0.01$). In exercise protocol, there was a positive correlation between reaction time and estradiol/progesterone ratio only during exercise at intensity of 30%HRR in a luteal phase ($r = 0.472$, $P < 0.05$).
Discussion
It has been reported that resting cognitive function decreased in young women with PMS and/or PMDD (Ju-Yu Y. et al, 2012). In the present study, there were positive correlations between reaction time and estradiol/progesterone ratio at rest and during low intensity exercise in a luteal phase in healthy young women. These results suggest that the increase in estradiol/progesterone ratio, i.e., imbalance of estradiol and progesterone, results in the decrease in cognitive functions at rest and during low-intensity exercise in a luteal phase in healthy young women.
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EXECUTIVE FUNCTION AND BDNF CONCENTRATIONS DID NOT DIFFER BETWEEN WELL TRAINED FUTSAL PLAYERS, SWIMMERS AND SEDENTARY MALE ADOLESCENTS AT REST.

PRADO, L.S., GORDON, D., QUINAN, G.Q., SHANG, F., NASCIMENTO, M.C., PENNA, E.M., CASTRO, G.C., SILVA, D.A.
FEDERAL UNIVERSITY OF MINAS GERAIS

Introduction
Physical activity has been associated with chronic and acute cognitive improvements, but the mechanisms involved are not yet completely elucidated. However, brain derived neurotrophic factor (BDNF) concentrations may be different between physical active and sedentary people. It has been postulated that the environmental enrichment achieved chronically during sports activities may play an important role

in enhancing cognitive function at rest. Aim of the present study was to compare executive function and blood BDNF concentrations at rest between high-level adolescent futsal players, swimmers and sedentary individuals.
Methods
14 male futsal players (FS) (16.2 ± 0.5 years old; 8.5 ± 1.9 years practice time), 14 male swimmers (Swim) (15.2 ± 0.8 years old; 9.6 ± 3.0 years practice time), and 8 sedentary adolescents (Control) (15.8 ± 0.8 years old), were volunteers in the present study. After 2 familiarization sessions, they performed the 5 digits test for the evaluation of executive function. Prior to the test, a blood sample was collected from the antecubital vein for determination of BDNF concentrations.
Results
No significant differences were observed in blood BDNF concentrations between the groups: FS (139,7 ± 38,25 pg/mL), Swim (162,9 ± 40,14 pg/mL) e Control (135,4 ± 40,77 pg/mL). Executive function also showed no significant differences between groups at rest: reading time (FS 15.79 ± 2.19s; Swim 17.64 ± 3.05 s; Control 18.50 ± 3.16 s); counting (FS 19.57 ± 1.87s; Swim 22.0 ± 3.37s; Control 22.88 ± 2.5s); inhibitory control (FS 30.29 ± 3.43s; Swim 34.07 ± 8.96; Control 35.50 ± 4.66s); and flexibility (FS 36.36 ± 4.20s; Swim 39.36 ± 8.63s; Control 45.88 ± 7.49s).
Discussion
In the present study we failed to observe any differences between swimmers, futsal players and sedentary adolescents in executive function, even though the athletes studied present a long practice time. This goes along with the fact that BDNF concentrations also did not differ between the investigated groups. The results indicate that the mode of physical activity may have no influence on executive function or BDNF concentrations. A comparison between athletes and sedentary people should be carried out to examine the effects of chronic physical exercise independently of physical activity mode.
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EFFECTS OF BRAIN ENDURANCE TRAINING ON ENDURANCE

DALLAWAY, N., LUCAS, S.J.E., RING, C.
UNIVERSITY OF BIRMINGHAM

Introduction
Mental fatigue (MF) impairs endurance exercise performance (Van Cutsem et al, 2017). Brain endurance training (BET) – such as engaging in mentally demanding cognitive tasks during exercise - can develop resilience to MF and improve physical performance compared to physical training alone (Marcora et al, 2015). However, only one study to date has demonstrated the effectiveness of BET, and the underlying mechanisms have yet to be determined. One hypothesis is that MF impairs physical performance via the anterior cingulate cortex (ACC), as it is activated by both exercise and complex cognitive tasks. Whether physical and mental tasks that activate the ACC have overlapping or additive effects on performance remains to be determined. This study aimed to examine if BET enhances performance over physical training and examine potential mechanisms.
Methods
Pre-training: 36 participants completed a rhythmic handgrip task requiring generation of as much force as possible by squeezing a dynomometer once a second for 300 s. This was performed under 3 counterbalanced conditions: following 600 s of a 2-back memory/attention task (subsequent); while performing a 2-back task (concurrent); and on its own (solo). Cardiac activity (ECG), electromyographic (EMG) forearm activity, pre-frontal cerebral haemodynamic (near infrared spectroscopy), and force were recorded continuously.
Training: Currently, 14 participants (randomized to a Control or BET group) have completed 6 weeks training (24 sessions) comprising of submaximal hand contractions, once a second, until reaching a force target relative to maximum voluntary contraction. The BET group completed concurrent cognitive tasks (2-back, word incongruence Stroop) by responding to visual stimuli with their non-dominant hand.
Post-training: Repetition of the pre-training protocol plus a novel cognitive task (number Stroop).
Measures of motivation, physical and mental exertion, mental fatigue and mood were collected via self-report throughout.
Results
Endurance performance improved more following BET than Control in the subsequent (26%), concurrent (24%) and solo (16%) physical tasks (p=.04-.14). Responses in the novel cognitive task were 22% faster in BET than Control (p=.01).
Discussion
Our preliminary results indicate that BET improved endurance performance with MF and increased cognitive performance over physical training. BET also aided in solo and concurrent physical performance. The full dataset (post-training measures of all 36 participants), including physiological and psychological measures, will be presented at the conference.
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Contact
nxd898@bham.ac.uk

PHYSICAL ACTIVITY BEFORE 16 YEARS OF AGE IS ASSOCIATED WITH THALAMUS VOLUME AND VERBAL MEMORY IN HEALTHY ADULT SUBJECTS

PRATS-PUIG, A.
EUSES UNIVERSITY SCHOOL, UNIVERSITY OF GIRONA, SALT, GIRONA; RESEARCH UNIT OF DIAGNOSTIC IMAGING INSTITUTE (IDI), GIRONA BIOMEDICAL RESEARCH INSTITUTE AND DR. JOSEP TRUETA UNIVERSITY HOSPITAL

Introduction
To study the association between physical activity during childhood and thalamus volumetric measures as well as verbal memory in healthy adults.
Methods
We mapped the thalamus volumetric values from magnetic resonance imaging (MRI) in 24 healhty adults (14 female; age 40.2±11.4 years) using a 1.5 T scanner. Imaging protocol included anatomic T1 turbo-field echo sequence with a spatial resolution of 1x1x1 mm.

Thalamic volumes were automatically segmented by using Freesurfer (Martino Center for Biomedical Imaging, Department of Radiology, Massachusetts). We estimated verbal memory by the Long Term Storage (LTS) Selective Reminding Test (SRT) subtests. We assessed physical activity in childhood using self-reported questionnaires. The relation between regular sports practice before 16 years of age with thalamus volume and verbal memory were analyzed by Spearman correlation followed by multiple regression using the enter method.
Results
Regular sports practice before 16 years of age, was positively related to thalamus volumes [left (r=0.672; p=0.002) and right (r=0.646; p=0.003) thalamus] as well as verbal memory [scores from SRT (r=0.502; p=0.024) and false positive responses (r= -0.675; p=0.001)]. Moreover, the false positive responses using the rey auditory verbal learning test were negatively related with left (r= -0.543; p=0.013) and right (r= -0.549; p=0.012) thalamus proper. The associations between the sports practice before 16 years of age with left thalamus volume (β=0.474; p=0.036; R2= 0.469) and false positive responses for the rey auditory verbal learning test (β=0.381; p=0.013; R2= -0.622) remained significant after correcting for confounding variables such as: age, gender and educational level.
Discussion
Practicing physical activity during childhood positively affects the volume of the thalamus, structure involved in motor and cognitive functions, as well as verbal memory in the adulthood.

TREADMILL RUNNING DECREASES THE ACCUMULATION OF AMYLOID IN LACTATIONAL DEHP-EXPOSED AGED RATS

LEE, Y.C., FANG, T.P., WANG, D.C.
TAINAN UNIVERSITY OF TECHNOLOGY

Introduction
Aerobic exercise can improve learning and memory by enhancing the expression of brain-derived neurotrophic factor (BDNF) (Singh and Staines, 2015). Early life exposure to di-(2-ethylhexyl)- phthalate (DEHP), a plasticizer usually applied in polyvinyl chloride manufacture, may impair the expression of BDNF in rats (Smith and Holahan, 2014). In this study, we investigated the effects of treadmill running on the expression of BDNF and the performance of spatial learning in aged rats that were exposed to DEHP during their lactational period.
Methods
Rat dams were fed with vehicle or DEHP (10 mg/kg per day) during lactation. After weaning, the male offspring were divided into 4 groups: control (C), DEHP (D), exercised control (Cex), and exercised DEHP (Dex). Rats were trained to exercise on a treadmill for 6 months from the ages of 18 months to 24 months and then the spatial learning was examined by Barnes maze. The functions of brain were evaluated by measuring the plasma levels of brain-derived neurotrophic factor (BDNF), hippocampal expressions of activity-regulated cytoskeleton-associated protein (Arc), and synaptophysin.
Results
The results demonstrate that the DEHP-exposed rats exhibited decreased spatial memory at their old age. Decreased expression of hippocampal Arc was observed in the DEHP-exposed animals at their old age. Importantly, in the DEHP-exposed animals, treadmill running during middle-age recovered the spatial memory by normalizing the hippocampal expressions of Arc at their old ages. Importantly, the study also showed that aggregation of β-amyloid was increased in the hippocampus of DEHP-exposed rats at their old age, while such aggregation was reduced in the exercised DEHP-exposed rats.
Discussion
Early-life exercise can enhance capacity to evoke memories and reduced risk of neurodegenerative diseases in later life. The findings of this study suggest that treadmill running may provide beneficial effects on ameliorating the dysfunction of brain in the lactational DEHP-exposed male rats at their old age.
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WHOLE-HAND WATER IMMERSION DOES NOT CHANGE CORTICOSPINAL EXCITABILITY IN HUMANS

SATO, D., YAMAZAKI, Y., YAMASHIRO, K., UETAKE, Y., NAKANO, S., ONISHI, H., TSUBAKI, A., BABA, Y., SHIMOYAMA, Y., MARUYAMA, A.
NIIGATA UNIVERSITY OF HEALTH AND WELFARE

Introduction
Previous studies have shown that whole-hand water immersion (WI) has no after-effect on corticospinal excitability in the primary motor cortex (M1) (Sato et al. 2015). However, the impact on corticospinal excitability during whole-hand WI is not well understood. In the present study, we examine the corticospinal excitability before, during, and after whole-hand WI in humans.
Methods
Nine healthy subjects participated in the present study. We evaluated motor-evoked potential (MEP) recruitment curves produced by a single transcranial magnetic stimulation (TMS) pulse, at increasing stimulus intensities. TMS intensities at 50%, 80%, 90%, 100%, 110%, 120%, 130%, and 150% of the resting motor threshold (rMT) were determined for each subject, and the same were used in all TMS assessments. A coil was held with the handle pointing backwards, laterally at approximately 45° to the sagittal plane, and was optimally positioned to obtain MEPs in the right flexor carpi radialis (FCR) muscle. Surface muscle responses were obtained using surface electrodes placed over the right FCR and extensor carpi radialis (ECR) muscle, using 9-mm diameter disposable adhesive silver/silver chloride surface electrodes. Electrodes were covered with a transparent film for waterproofing. The experimental sequence included two baseline TMS assessments taken prior to WI (B1 and B2), immediately (WI1) and at 10 min (WI2) after starting whole-hand WI for 20 min, and immediately after WI (P1) and at 10 min (P2) after WI. Water temperature was set at 27°C. Skin temperatures of both arm and hand surfaces were continuously measured throughout the experiments.
Results
One-way repeated measures ANOVA revealed no significant change in rMT ($p>0.05$). Additionally, two-way repeated measures ANOVA found that the MEP amplitudes were significantly affected by stimulus intensity ($p<0.05$); whereas, there is no impact of time on the MEP recruitment curve ($p>0.05$), and no interaction ($p>0.05$) in the ECR and FCR muscles, respectively.
Discussion

The present results reveal that whole-hand WI does not affect corticospinal excitability in M1. Although, in previous studies (Golaszewski et al. 2012), afferent inputs have shown an increase in the MEP recruitment curve. One explanation for these results is that the stimulus intensity induced by whole-hand WI is not enough to cause a change in corticospinal excitability.

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MODELLED BEHAVIOR AND ERROR DETECTION IN AN ABSTRACT SEQUENCING TASK

GULDE, P., LEIPPOLD, K., ARMSTRONG, A., GRIMMER, T., KOHL, S., DIEHL-SCHMID, J., HERMSDÖRFER, J.
TECHNICAL UNIVERSITY OF MUNICH

Introduction
The clinical scoring of tests is commonly done via video, and the detection as well as classification of non-parametric performance parameters is crucial for a reliable assessment of patients. The reciprocal trail making task is assessing the ability to arrange abstract actions into an appropriate order. Such a task, thought to simulate demands of complex instrumented activities of daily living, can be modelled and an automated error detection can be applied.
Methods
The performance in the reciprocal trail making task of 11 patients suffering from dementia (76.7a±4.8a) was translated to a transition matrix (states: 8 steps + start + end) (Gulde et al., 2017). Based on this matrix 1mio trials were simulated and an automated error detection was applied (MATLAB R2015a, MathWorks, Natick, MA, USA). The human scoring (1 rater) of the original data was compared to the automated scoring of the simulated trials. Used parameters were the sum of errors, the number of errors of addition (Addition), of omission (Omission) and of sequence (Sequence), the relative number of steps (Rel Steps) and the percentage of correct trials (% Right).
Results
The transition matrix revealed a probability diffusion in the central area with probabilities decreasing from .71 to 1.00 in the first and last two steps to .38 to .83 in the central steps of the task. A comparison of the scores of the original data with the scores of the simulation by 2-sided t-tests revealed comparable results for both scorings (Addition model: .59±1.3, sample: .42±.67, p=.66; Omission model: .90±.88 , sample: .75±.62, p=.56, Sequence model: .11±.36 , sample: .25±.45, p=.20, Rel Steps model: .97±.25 , sample: .96±.13, p=.92, % Right model: .11, sample: .08, p=.64). The total number of errors was comparable with 1.60±1.28 errors per trial in the model and 1.42±.79 errors per trial in the sample (p=.64).
Discussion
The automated scoring of the simulated data revealed comparable results to the scores of the sample. In this state of the error detection, human raters would have to manually input the arrangement of action steps to the software. Utilizing motion capturing and/or contact detection (e.g. by touch screens) this could be automated as well in the future. Such automated scorings have the potential to reduce the workload of the clinical staff and to improve the main quality criterions when assessing patients.

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Contact
philipp.gulde@tum.de

Conventional Print Poster

CP-PM19 Children and adolescents

INVESTIGATION OF SHOULDER INJURIES AMONG JAPANESE FEMALE WATER POLO PLAYERS

IIZUKA, S., TORII, S.
WASEDA UNIVERSITY

Introduction
Athletic movement of the water polo contains both swimming and throwing. Therefore water polo is the sport that has higher load to shoulder. In the previous researches, shoulder was the highest site of the water polo injury(Colville, J. M. et al., 1999). However, incidence of shoulder injury in different age groups of Japanese female water polo players has been unknown. Now the purpose of this study was to determine the incidence of the shoulder injury of the Japanese female water polo player.
Methods
One hundred fifty one athletes (65 junior high school students, 48 high school student and 38 college students) were surveyed using questionnaire about injury history, training volume (water polo and weight training), stretching and icing, who participated in a national championship in Japan. Statistical analysis software (SPSS Statistics 21, IBM Japan Inc.) was used for the analysis, with the alfa level set at 5%.
Results
Seventy six players (50.3%) had the history of shoulder disorder, 46 of them(30.5%) answered to have persistent pain at the time of this survey. The experience of shoulder injury significantly increased with age (r= 0.908, p= 0.000). As a result of logistic-regression analysis, age and Starting age of Waterp polo showed significant association with a history of previous injury of the shoulder.
Discussion
The preliminary research reports that the player who had a shoulder disorder was 24% (Annett P, et al., 2000). The results of this study showed a ratio more major than the preliminary research. A Japanese female water polo player has many persons having a small body. Therefore the load to a shoulder to receive by a throw and physical contact is big, and, as a result, the risk of developing shoulder injury is thought to increase. Also, a history rate of the shoulder disorder rises as the player who competition initiation age is young, and has a long competition years of experience. In other words it is thought that an overuse by the daily training is one of the major causes of the shoulder disorder.
Conclusion: In a Japanese female water polo competition player, more than 50% of players had the history of previous shoulder disorder.

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DETERIORATION OF THE SPRINT MOTION CAUSED BY ADOLESCENT AWKWARDNESS FOR ELEMENTARY SCHOOL CHILDREN

KOKUDO, S.
KOBE UNIVERSITY

Introduction
The adolescent awkwardness of sprint was investigated from the speed decline (Bounen & Malina(1988)); however, the awkwardness of the motion is unclear. The purpose of this study was to investigate the deterioration of the sprint motion coursed by adolescent awkwardness on elementary school children.
Methods
Observational sprint motion causal model, which includes 36 checkpoints, was developed based on the biomechanical findings and the descriptive checkpoints of previous studies (e.g. Knudson & Morrison (2002)). All of the observation point was evaluated in the 2-3 category. Intermediate sprint motions (25-35m of 50m sprint) and sprint speed (SS) and of 458 children (241 boys and 217 girls), 4th - 6th grade of elementary school, were recorded by sensor timer and digital video cameras. Their forms were played in slow motion or frame-by-frame, and 6 investigators evaluated the checkpoints.
Factor analysis using maximum likelihood method was applied in order to identified sprint motion factors. Oblique rotation by promax criteria was applied to the extracted factors, and the factors were interpreted from factor pattern matrix. Correlation coefficients between factor scores, sprint speed and height were calculated in order to confirm that the motion factors which have positive correlation with SS though negative correlation with height.
Results
As the results of factor analysis, 7 factors were extracted from selected 28 observation points, their 42.0% of total variance was explained by these 7 factors. Each factor was interpreted as grounding preparation motion (GPM), body-axis construction motion (BCM), arm pumping motion (APM), leg push and release motion (LPR), arm swing-back motion (ASM), leg drive motion (LDM), and grounding motion (GM), respectively. The significant correlation coefficients were observed between GPM, BCM, APM, ASM, LDM, GM and sprint speed ($r=.401$, .264, .383, .287, .430 and .163 for boys and .239, .160, .229, .133, .316 and .135 for girls ($p<.05$), respectively). These sprint motions were associated with SS for both boys and girls. Significant negative correlation was observed between BCM, and height (-.130 for boys, -.160 for girls ($p<.05$)).
Discussion
The contradiction result of BCM, which had positive relationship with SS but negative relationship with height, presumed to be due to adolescent awkwardness; adolescent growth spurt makes difficult to construct the body axis motion satisfactorily.
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Supported by Grant-in-Aid for Scientific Research(C), (16K01596) Japan.
Contact
skokudo@dolphin.kobe-u.ac.jp

STRESS SONOGRAPHY OF THE ULNAR COLLATERAL LIGAMENT OF THE ELBOW IN JUDO PLAYERS

FUKUDA, Y.1, TEJIMA, R.1, TAMAI, Y.1, HIROKAWA, M.2, TOKUYASU, H.1, YAMAGUCHI, T.1, TABUCHI, K.1, YUZUKI, O.1, KOYAMA, K.1
1: TOKYO ARIAKE UNIVERSITY OF MEDICAL AND HEALTH SCIENCES (JAPAN), 2: TOIN UNIVERSITY OF YOKOHAMA (JAPAN)

Introduction
Stress ultrasound, according to a recent study, revealed that the ulnar collateral ligament (UCL) in the dominant elbow of asymptomatic baseball pitchers is thicker and has increased laxity with valgus stress (Ciccotti et al., 2014). Judo players often experience elbow injuries due to repetitive valgus stress to their lifting hand ("tsurite") during "Seoi-Nage" (shoulder throw). However, no reports have documented the elbow condition of judo players on stress ultrasound. We hypothesized that judo players would develop morphological changes in the lifting hand, such as thickening of the UCL and increased ulnohumeral joint space. The purpose of the study was to compare the condition of the UCL and ulnohumeral joint space between the lifting hand and pulling hand ("hikite") in Japanese judo players using stress ultrasound.
Methods
The subjects were 71 Japanese judo players (male, 61; female, 10; age, 16.7±2.6 years; height, 166.7±9.7 cm; weight, 74.7±19.3 kg; years of experience, 9.8±3.2), recruited from the All Japan Judo Federation. All judo players were asymptomatic at the time of this study. Stress ultrasound examinations were performed with 30° of flexion, at rest and under 40 N of valgus stress. The UCL thickness and ulnohumeral joint space width were measured in the lifting hand and pulling hand.
Results
There was a statistically significant difference in UCL thickness between the lifting hand and pulling hand at rest (stressed: lifting hand 5.4±1.0 vs. pulling hand 5.2±1.1 mm; $P=0.13$; unstressed: lifting hand 5.7±1.1 vs. pulling hand 5.2±1.1 mm; $P<0.05$). The ulnohumeral joint space was similar between elbows under stressed and unstressed conditions (stressed: lifting hand 4.0±2.1 vs. pulling hand 3.9±1.7 mm; $P=0.75$; unstressed: lifting hand 3.1±1.7 vs. pulling hand 3.0±1.8 mm; $P=0.78$). The mean change in joint space from rest to the stressed condition was 0.9 mm in the lifting hand and 0.9 mm in the pulling hand ($P=0.88$).
Discussion
UCL thickness in the lifting hand was greater than that in the pulling hand in judo players. Ciccotti et al. reported that the UCL in the dominant elbow of pitchers was thicker. We believe that the judo players had developed UCL thickness, as previously reported for elite baseball pitchers. In conclusion, repetitive valgus stress to the lifting hand during "Seoi-Nage" might affect UCL thickness in judo players.
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Contact
fukuday@tau.ac.jp

FATIGUE, PHYSICAL FUNCTION AND PHYSICAL ACTIVITY IN YOUNG ADULT WOMEN.

AZEVEDO, L.M.M., DE LIMA, F.D., BOTTARO, M., VALERIANO, R.O., CORREIA, A.L.M., NERI, S.G.R., DE OLIVEIRA, R.J., DE LIMA, R.M.

UNIVERSIDADE DE BRASILIA

The purpose of this study was to assess fatigue, body fat, strength, and muscle quality in healthy young adult women, as well as to evaluate the relationship between fatigue, physical function and physical activity. Fifty-one (51) young adult healthy women aged between 20 and 45 years were enrolled in this study. Fatigue was assessed using the MFI-20 questionnaire, muscle strength using an isokinetic dynamometer, body composition using DXA, muscle quality and thickness using a B-mode ultrasound. The relationship between perceived fatigue, physical function and characteristics were verified by Pearson's correlation. To assess the role of physical activity in general and physical fatigue, the subjects were allocated in two groups: inactive group (INA; n=21: age:32.27±7.39) and active group (ACT; n=30; age:31.77±6.62). To compare these two groups, an independent T-test was used. It was adopted p≤0.05. The variables age (p=0.016), weight (p=0.001), height (p=0.021), BMI (p=0.018), percent body fat (p=0.002) were significant correlated with physical fatigue. No significant correlations with perceived fatigue were observed for strength, muscle thickness and muscle quality (p>0.05). There was a significant difference between groups in weight (p=0.045), body mass index (p=0.05), percent body fat (p=0.002), fat mass (p=0.004), echo intensity (p=0.036), specific torque (p=0.041), general fatigue (p=0.019) and physical fatigue (p=0.035). General and physical fatigue were related to weight and body fat, but not to strength and muscle quality. Additionally, physically active women showed lower perceived fatigue, weight, body fat and greater muscle quality than physically inactive women. It seems the practice of physical activity plays an important role in fatigue prevention due to its impact in physical function and it's characteristics.

INVESTIGATION OF MOTOR SKILLS OF 11-14 AGED ADOLESCENT ACCORDING TO BMI

GOZEL TEPE, Z.

GRADUATE SCHOOL OF HEALTH SCIENCES

Introduction
In this study, it was aimed to determine with body mass indexes (BMI), whether there was statistically significant difference between the basic motor skills levels of the 11-14 age group middle school students by means of Dordel-Koch test (DKT).
Methods
The research was applied onto the middle school students in Turkey developed by Dordel-Koch, which were performance tests, side to side jump test (SSJ), flexibility test (F), Standing Long Jump test (SLJ), sit up test (SU), Single leg Balance test (SLB), push -up test (PU) and 6 Minute run test (6MR). The weight and height measurements of the students and the BMI indices are calculated. Students with a BMI percentile was described as below 5% were slim , between 5-85% normal, between 86-95 percentile overweight and above 95% percentile obese groups (Neyzi, O., 2002; Nail, 2009). 11 years old 261 students (146 boys, 115 girls), 12 years old 380 students (212 boys, 168 girls) ,13 years old 329 students (192 boys , 137 girls) and 390 students 14 years old (204 boys , 186 girls). A total of N = 1360 volunteer students participated in the study. There are N = 117 (8.6%) in slim BMI group, N = 989 (72.7%) in normal BMI group, N = 133 (9.8%) in overweight BMI group and obese BMI group N = 121 (8.9%) students, upon all participants were examined judging by BMI groups. As a statistical method, firstly descriptive statistics were applied, then the data obtained from the participants were divided into gender and age groups in order to determine whether there is a significant difference according to BMI values and $\alpha = 0,05$ at significance level One Way Anova test is applied. Tukey's HSD test, a second level test, was applied among the groups with significant differences.
Results
As a result, according to BMI groups there were statistically significant differences in $p < 0,05$ value in each age group in boys. These values indicate that the obese BMI groups have low values were found compared to all other groups which the tests demanding strength and endurance in the YS, DUA, M and 6DK tests. In girls, statistically significant differences were found in $p < 0.05$ compared to BMI groups in all age groups and it was found that the obese BMI group have lower values in the endurance test than the other groups in the 6 DK test.

PREFERENCES OF PHYSICAL EDUCATION AND PLAYS IN 10-12 YEAR-OLD CHILDREN IN EAST ASIA

IKEDA, T.1, HAN, N.2, CHOI, T.2, AOYAGI, O.3

1 FUKUOKA PREFECTURAL UNIVERSITY, 2 JEJU NATIONAL UNIVERSITY, 3 FUKUOKA UNIVERSITY

Introduction
In recent years, inactivity among Asian children has been cited (Muller et al., 2013). Japan and South Korea are both located in East Asia and are facing similar problems with declining physical fitness and obesity (Tomkinson et al., 2007; Ha et al., 2013). Children's physical activity is influenced by their preferences in physical education (PE) (Kano, 2014). The purpose of this study was therefore to investigate and compare preferences in PE and play in 10-12 year-old children.
Methods
The research participants were 1,689 Japanese and Korean children aged 10 to 12 years. All participants completed a questionnaire relating to their preferences in PE, 12 types of PE and 22 kinds of play. Responses were given on a five-point scale from "strongly dislike" (1 point) to "strongly like" (5 points). Factor analysis was applied to investigate the factors determining preferences for types of PE and play.
Results
Three factors pertaining to types of PE were extracted: gymnastics (G), track & field and ball games (TF&B) and swimming (S). Five factors related to play were extracted: equipment (E), ball (B), tag (T), video games (VG) and hobbies (H). ANOVA for PE showed a significant difference in gender alone (Fo = 103.2***, boys (B) > girls (G). For factors of types of PE and play, the effect of nationality was found to be significant in TF&B (Fo = 21.5***, Japan (J) > Korea (K)), S (Fo = 38.1***, J > K), B (Fo = 26.1***, J < K) and VG (Fo = 178.52***, J > K). Conversely, as a significant interaction effect between nationality and gender was detected in ANOVA, the multiple comparison test was applied for G (to = 4.1*, KB > KG; to = 7.2*, KG < JG), E (to = -12.0*, JB > JG; to = 10.2*, KG < JG), T (to = -3.5*, KB < KG; to = 3.4*, KB < JB) and H (to = 19.2*, JB > JG; to = 16.5*, KB < JB; to = 5.3*, KB > KG).

Discussion
Japanese children prefer PE more than their Korean counterparts. However, Korean children prefer active play while Japanese children prefer inactive play. These results imply that severe stress associated with entrance examinations exists in Korea. These findings revealed differences between Japanese and South Korean children in relation to preferences in PE and play.
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HEALTH-RELATED PHYSICAL FITNESS IN ELEMANTERY SCHOOL-AGED CHILDREN IN NORTH CYPRUS

KIRMIZIGIL, B., MALKOC, M., TUZUN, E.H., ANGIN, E., GOZDE, I., ZABIT, F., MIHCIOGLU, S.
HEALTH SCIENCE

Introduction
There is relatively little known about current levels of health-related physical fitness in North Cyprus children,aside from documanted statistics on prevelance of overweight and obesity. In a crowded modern world it is vital that the promotion of sport and exercise should be compatible with environmental and public health outcomes.This study aims to assess health-related physical fitness in elemantery school -aged children in North Cyprus.
Methods
The study consisted of 359 students aged respectively between 5 and 10, who attend a private elementary school in North Cyprus. Health -related physical fitness were assessed by using FITNESSGRAMM (FG) Test battery. FG test battery,which includes assesments of aerobic capacity(AC), body mass index (BMI), abdominal strength and flexibility. Age-and sex-specific health-related criterion-referenced standarts were used to classify fitness results into the health fitness zone (HFZ), needs improvement zone (NIZ) or needs improvement health risk (NIHR).
Results
The study is based on 164 girls and 195 boys. The BMI of individuals are estimated to be between 16.56±1.48 - 19.32±4.18 kg/m2. On the word of the classifications of FG body composition, 207 (57.7%) students are considered to have HFZ levels. On the other hand, 137 (38.2%) students are studied to be at a risk of poor health and NIZ. By means of body composition, 8-year-olds have the largest distribution of poor physical health and require the most attention with a leading %30.7 amongst other students. Despite this critical information, 5-year-olds appear to cause little concern with a low 9.1% of individuals at the risk of poor health. This study shows that the girls and also boys between the ages of 5 and 10 years, at high risk and in NIHR. Only the 10 year-olds students aerobic capacity had been evaluated and it was found in the HFZ.
Discussion
Elemantary physical education can be improved with a program that is feasible in real-world setting. The results in our study also support the conclusion that the elementary school administrators and teacher in North Cyprus are encouraged to adopt health-related physical education programs that are effective in providing children with substantial amounts of physical activity.

THE SPECIFIC EFFECTS OF DEVELOPMENTAL STAGE ON PHYSICAL ABILITY IN ADOLESCENT FEMALE FOOTBALL PLAYERS

INOUE, Y.
KOBE INTERNATIONAL UNIVERSITY

Introduction
Adolescent female athletes exhibit a higher incidence of sports and severe injuries. The reason proffered for this is that in female adolescents, muscular strength does not increase with physical growth, unlike in male adolescents. However, few studies have investigated the relationship between physical growth and physical ability.
Methods
This study aimed to investigate the influences of the stage of development on strength, power, speed, balance, and endurance in adolescent female football players. The participants were 42 junior high and high school female football players. They were classified into three groups based on Puberty Category Scores; Group I (GI): 6 participants with Score 1 (pre-pubertal), Score 2 (early pubertal), and Score 3 (mid-pubertal); Group II (GII): 11 participants with Score 4 (late pubertal); and Group III (GIII): 25 participants with Score 5 (post-pubertal)
The isokinetic knee flexion and extension peak torque were measured by 60° and 300°/second on the left leg. The modified star excursion balance test, single leg standing test with the eyes closed, vertical jumping test, three-steps hopping test, agility tests, and intermittent Yo-Yo test were performed. The 40-m linear sprint time was also measured. One-way analysis of variance was conducted to compare each of the variables between the three groups. SPSS PASW21 was used for statistical analysis and statistical significance was set at $p < 0.05$.
This study was approved by the Ethical Committee Board of Kobe International University, Japan.
Results
Regarding participant characteristics, age (GI< GII*, GI< GIII*), height (GI< GIII*, GII< GIII*), body weight (GI< GII*, GI< GIII**), and body mass index (GI< GII**, GI< GIII**) showed significant differences between the groups.(*; p<0.05, **; P<0.01) GI significantly had a higher knee extension peak torque (300°/second) than GII, and the hopping test showed a significantly longer distance for the right leg in GII than in GIII.
Discussion
Female football players have higher activity in the rectus femoris during side-cutting or side-stepping than male players. The knee extension strength on high speed relative to body weight in GII decreased temporarily with increasing body weight. This suggests that knee extensor weakness might lead to dynamic instability during performance, leading to sports injuries in adolescent female players. This study indicates that to prevent sports injuries in adolescent female football players, it is essential to increase their body weight so that knee extensor strength is improved during higher speeds.

EXAMINING THE EFFECT OF ETHNICITY AND LANGUAGE ON FUNDAMENTAL MOVEMENT SKILLS IN CHILDREN FROM LOW SES BACKGROUNDS IN COVENTRY, UK.

EYRE, E.L.J., DUNCAN, M.J.

COVENTRY UNIVERSITY

Introduction
The development of fundamental Movement skills (FMS) is associated with health in children. While there is some evidence to suggest that age, sex, physical activity, SES is associated with FMS (Barnett et al., 2016), the role of ethnicity and language barriers in FMS competence is underexplored. This may be of particular interest for South Asian children who have lower physical activity (Eyre et al., 2013) and increased risk of metabolic disease (Whincup et al., 2002). The aim of the study was to examine ethnic and language differences in FMS between White and South Asian children and children who speak English as their first language and those whose first language is not English, from low SES areas in West Midlands, UK.
Methods
Following ethical approval, 89 children aged 6-10 years (43 White EU, 46 South Asian, 43 male, 46 female, English first language = 54, English not first language = 35) were recruited from low SES areas of West Midlands, UK. Each child was assessed performing 4 locomotor skills (run, skip, hop, and jump) and 4 object skills (catch, kick underarm throw and overarm throw) according to the Test of Gross Motor-2, 3 checklist (Ulrich, 2001). A 2 (sex) by 2 (ethnicity) by 2 (English first language, English not first language) factor ANCOVA assessed differences in locomotor composite score, object composite score and total FMS, whilst controlling for age. Significance was set at $p<0.05$ a prior.
Results
After adjusting for age as a significant covariate ($p<0.001$), ethnic differences in total FMS ($p=0.002$), Locomotor $p=0.042$) and Object control skills were found ($p<0.001$). South Asian children had poorer total (mean difference=6), locomotor (mean difference =2.6) and object control skills (mean difference=3.9) compared to White British children. No main effect for gender or language (English as a first language or English not as a first language) were found ($p>0.05$).
Discussion
The findings suggest that South Asian children irrespective of age, gender or whether their first language is English or not, have poorer fundamental movement skills than White British children. The mechanisms underpinning this are unclear but could relate to lower physical activity patterns and body compositional differences. Further research should examine the association between FMS, body composition and physical activity in an ethnic sample to confirm this.
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PERFORMANCE ANALYSIS FOR ESTABLISHING AN INNOVATIVE LECTURE STYLE AT UNIVERSITY.

MAGOME, T.1, GOUDA, N.2, TANAKA, T.3, NAKATA, K.1

1:OSAKA UNIVERSITY GRADUATE SCHOOL OF MEDICINE(JAPAN), 2: GOVERNMENT & PUBLIC CORPORATION INFORMATION SYSTEMS DIVISION, HITACHI,LTD(JAPAN), 3:RESEARCH & DEPARTMENT GROUP, HITACHI,LTD.(JAPAN)

Introduction
The role of sports that can maintain mental and physical health is important to improve the students' QOL. [1] Particularly in the university lecture, which is unlike competition sports, the physical education teachers are required to promote the exercises effectively for students varying in the sex and exercise career. However, an evaluation have not been accomplished by the quantitative effects in the past. In this study, it is measured that the effects to promote exercise using a motion sensor and a position sensor by performing a ball game.
Methods
The lecture carried out every week for six months. The measurements with the sensor were performed in the beginning and the end during the lecture period. Students attached the acceleration sensor of the 20Hz sampling to their arms and the momentum in the ball game was estimated. [2] In addition, the players' position was monitored by the laser radar. [2] Improvement of the cooperation in the group was examined from the collected data.
Results
Comparing the beginning and the end of the lecture, momentum increased by 41.2% for men, 28.8% for women, and 36.9% for all players. In addition, the progress of the cooperation was suggested by the team which players improved a ball game.
Discussion
Increase of momentum indicates that students participated in a game positively and took exercise efficiently. Having the positive impression for sports through a lecture will enhance the important awareness to lead to the daily health promotion. In recent years, personal performances of professional football players are analyzed and quantified to connect to the next exercises. [3] Therefore, the relative evaluation with this lecture is possible by comparing the result from this study with DATA including acceleration of football players etc. However, continuous measurements are needed because the sampling numbers are not enough. To establish a new lecture-style based on scientific grounds leads to evidence construction in the physical education and contributes to development of the sports medicine.
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14:00 - 15:00

Mini-Orals

MO-PM01 Clinical aspects of health and fitness

MEMORY FLEXIBILITY IS A LINK BETWEEN PHYSICAL-ACTIVITY RELATED ENDURANCE AND HIPPOCAMPAL MEMORY IN YOUNG ADULTS

SUWABE, K.1, HYODO, K.2, BYUN, K.1, OCHI, G.1, FUKUIE, T.1, YASSA, M.A.3, SOYA, H.1

1UNIVERSITY OF TSUKUBA (IBARAKI, JAPAN), 2PHYSICAL FITNESS RESEARCH INSTITUTE (TOKYO, JAPAN), 3UNIVERSITY OF CALIFORNIA, IRVINE (CA, USA)

Introduction
A physically active lifestyle is beneficial to hippocampal memory function (Erickson et al., 2009). While a potential mechanism for this effect is exercise-enhanced neurogenesis in the dentate gyrus (DG), a sub-region of the hippocampus (Okamoto et al., 2012), the association of physical activity (PA) and PA-related endurance capacity with DG function is unknown. Computational models of hippocampal memory processing postulates that enhanced DG function leads to "memory flexibility": a selective improvement in the ability to discriminate similar experiences with a moderate level of interference (Leal & Yassa, 2015). We hypothesized that if PA-enhanced endurance is related to DG function, then endurance should be selectively associated with discrimination performance for moderate interference.
Methods
We assessed 75 healthy young adults' VO2peak as a physiological indicator of endurance capacity associated with PA. PA levels were measured by questionnaire (IPAQ). To assess DG-related memory performance, we adopted a mnemonic discrimination task which evaluates discrimination performance for lure stimuli (similar but not exactly the same) sorted into three bins (high-, middle-, low-similarity), thereby parametrically manipulating mnemonic similarity.
Results
When divided into two groups based on a median split of VO2peak, participants in the higher fitness group outperformed those of the lower fitness group in discrimination score for moderate interference levels (DS_Mid). Differences between groups were confirmed by correlational analyses across all participants, in which VO2peak and PA were selectively associated with DS_Mid. A mediation model showed that VO2peak predicted DS_Mid as a mediator of PA effects.
Discussion
Better hippocampal memory in higher endurance participants manifested as memory flexibility, and suggests that fitness is strongly associated with DG-related memory function. The mediation model of a triadic relationship between PA, VO2peak and DS_Mid suggests that a potential neurobiological mechanism underlying this association is PA-enhanced neural plasticity in the DG. Future research must check the involvement of the DG as a neural substrate underlying this association and confirm the causal effect of exercise using MRI. Our results show, for the first time, specific links between endurance and DG-related memory performance, and propose an alternative hypothesis that endurance are associated with DG-mediated memory processing.
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EFFECT OF EXERCISE TRAINING ON CARDIAC INFLAMMATION AND FIBROSIS IN HYPERTENSIVE OVARIECTOMIZED RATS

LIN, Y.Y.1, YANG, A.L.2, LEE, S.D.1,3

1: CHINA MEDICAL UNIVERSITY (TAICHUNG, TAIWAN); 2: UNIVERSITY OF TAIPEI (TAIPEI, TAIWAN); 3: ASIA UNIVERSITY (TAICHUNG, TAIWAN)

Introduction
Cardiac inflammatory changes trigger reactive myocardial fibrosis by estrogen deficiency in individuals with hypertension, which may linked to the rapid increase in the risk of developing heart failure. Exercise training is good for cardiovascular health, but no information regarding the effects of exercise training on cardiac inflammation and fibrosis in hypertensive ovariectomy was available. The purpose of this study was to evaluate the exercise training on cardiac TNF-α/NFκB inflammatory and cardiac TGF-β/CTGF fibrotic pathways in hypertensive ovariectomized rats.
Methods
Forty-two female spontaneously hypertensive rats (SHR) were divided into a sham-operated group (SHR-S), bilaterally ovariectomized group (SHR-O) and bilaterally ovariectomized rats underwent treadmill running exercise for 8 weeks (SHR-OT) as well as fourteen female normotensive Wistar Kyoto rats (WKY). After training or sedentary status, the excised hearts were measured by H&E staining, Masson trichrome staining and Western blotting.
Results
The SHR-O group exhibited abnormality myocardial architecture and interstitial fibrosis relative to the WKY and SHR-S groups, whereas those parameters were improve in the SHR-OT group when compared with the SHR-O group. After ovariectomy caused the protein levels of ERα and ERβ to become more decreased in the SHR-OVX group compared with the WKY and SHR-S groups, but exercise training did not further change those in the SHR-OT group when compared with the SHR-O group. The protein levels of TNF-α, p-IKKα/β, p-NFκB, COX-2, iNOS and IL-6 (TNF-α/NFκB inflammatory pathway) as well as TGF-β, p-Smad2/3, p-ERK1/2, CTGF, tPA, MMP2 and Collagen I (TGF-β/CTGF fibrotic pathway) were increased in the SHR-O group relative to the WKY and SHR-S groups, whereas they were decreased in the SHR-OT group when compared with the SHR-O group.
Discussion
Exercise training suppressed TNF-α/NFκB inflammatory and TGF-β/CTGF fibrotic pathways in hypertensive ovariectomy. Our findings suggested that exercise therapy could be one of possible therapeutic approaches to prevent cardiac inflammation and fibrosis, which would ameliorate cardiac abnormalities in hypertensive postmenopausal women.

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Contact
charlet8116@gmail.com

PHYSICAL PERFORMANCE IN ADVANCED LUNG CANCER PATIENTS AFTER A 12-WEEK EXERCISE INTERVENTION: PRELIMINARY RESULTS OF THE POSITIVE STUDY

TITZ, C., HUMMLER, S., THOMAS, M., WISKEMANN, J.
DEUTSCHES KREBSFORSCHUNGSZENTRUM HEIDELBERG

Background
Advanced lung cancer patients suffer from incurable disease with poor prognosis (median survival <12 months). Patients experience multidimensional impairments during their course of disease/treatment which may often result in physical fragility. The benefits of exercise have been reported for early stage lung cancer patients. However, the evidence regarding the efficacy of exercise interventions in advanced lung cancer patients remains unclear.
Methods
The POSITIVE study (Part III) enrolled patients with advanced lung cancer not eligible for surgery to analyse the effects of a 24-week individually tailored, combined resistance and endurance exercise intervention on quality of life and physical performance (ClinicalTrials.gov NCT02055508). From November 2013 until December 2016, 232 patients (134 men, 98 women) were recruited and randomised into two groups. Both groups received weekly care management phone calls with the goal to provide similar social contact in both groups and to assess symptoms. The intervention group additionally exercised 3x/week both home-based with an exercise manual and in local gyms under supervision of physiotherapists. Primary endpoints include assessment of quality of life and fatigue after 12 weeks. Secondary endpoints are physical, psychosocial and immunological parameters as well as overall and progression-free survival. Physical performance and endpoints are assessed at baseline and in 12-week periods for a maximum of five assessments.
Results
Physical performance assessment (after 12 weeks) has so far been completed by 132 patients. For patients showing good exercise adherence (3 times/week), there were significant differences between control and intervention group in elbow flexors (p=.02) and knee extensor (p=.03). For patients who exercised regularly in a local gym significant differences were additionally reported for knee flexors (p=.03) and hip abductors (p=.04).
Discussion
These preliminary results demonstrate the feasibility and effectiveness of the exercise program for patients with advanced lung cancer. Results regarding the effects on quality of life and fatigue are awaited.

EFFECTS OF 10 WEEKS ATORVASTATIN TREATMENT ON MUSCLE DAMAGE, MUSCLE STRENGTH, AND MITOCHONDRIAL FUNCTION IN RAT SKELETAL MUSCLES

KWAK, H.B.1, KIM, C.J.2, SEO, D.Y.3, PARK, D.H.1, NO, M.H.1, HEO, J.W.1
1: INHA UNIVERSITY, 2: KYUNGHEE UNIVERSITY, 3: INJE UNIVERSITY

Introduction
Statins (3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitors) are cholesterol-lowering drugs widely used in the treatment of cardiovascular disease (Koh et al., 2011). However, statins also cause adverse side effects in skeletal muscle ranging from fatigue to fatal rhabdomyolysis. Recently, we found that long-term (48 hour) treatment of simvastatin induced cell death due to impaired mitochondrial respiration and oxidative stress leading to mitochondrial apoptotic signaling in primary human skeletal muscle cells (Kwak et al., 2012). The purpose of this study was to determine the effects of in vivo atorvastatin treatment on muscle damage, muscle fatigue/strength, and mitochondrial function (e.g., mitochondrial respiration, H2O2 emission, Ca2+ retention capacity) in rat skeletal muscles.
Methods
Male Wistar rats were randomly assigned to control (CON), 5 mg atorvastatin treated group (5 mg ATOR), or 10 mg atorvastatin treated group (10 mg ATOR) (N=12 rats/group). Animals were administered via oral gavage with vehicle, 5 mg/kg/day atorvastatin, or 10 mg/kg/day atorvastatin dissolved in 0.25 % w/v hydroxylpropyl methylcellulose for 10 weeks. Forelimb muscle strength and serum creatine kinase (CK) concentration (i.e., muscle damage marker) were measured. The skeletal muscles such as soleus (SOL, Type I) and white gastrocnemius (WG, Type IIb) were permeabilized by sarponin for determination of mitochondrial respiratory capacity, mitochondrial H2O2 emission, and Ca2+ retention capacity.
Results
Maximal forelimb strength was significantly decreased after 4 week (5 mg ATOR) or 6 week (10 mg ATOR) atorvastatin treatment in a dose dependent manner ($P<0.05$). Serum CK concentration was significantly higher in 5 mg ATOR and 10 mg ATOR after 10 weeks treatment compared with CON ($P<0.05$). The mitochondrial respiratory capacity and Ca2+ retention capacity were significantly decreased by 10 weeks of 5 mg ATOR and 10 mg ATOR in both SOL and WG in a dose dependent manner ($P<0.05$). 10 weeks atorvastatin treatment significantly increased mitochondrial H2O2 emission rate in both SOL and WG in a dose dependent manner ($P<0.05$).
Discussion
These data demonstrate that long-term treatment of atorvastatin results in muscle damage, reduced muscle strength, and impaired mitochondrial function in skeletal muscles in a dose dependent manner, suggesting that skeletal muscle mitochondrial dysfunction may be associated with muscle damage and muscle fatigue induced by atorvastatin treatment.
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Contact
kwakhb@inha.ac.kr

EFFECTS OF INCREASING CENTRAL ARTERIAL STIFFNESS ON CEREBRAL BLOOD FLOW PULSATILITY IN RESISTANCE-TRAINED MEN

NAKAMURA, N.1, MURAOKA, I.2

1: GRAD, WASEDA UNIV, 2: WASEDA UNIV

Introduction
Central arteries (e. g., the aorta and carotid artery) buffer blood flow pulsatility. Increased central arterial stiffness decreases buffer function and increases cerebral blood flow pulsatility. Increased cerebral blood flow pulsatility leads to increased risk of cerebral microvascular damage. Resistance training (RT) has recently been recommend for performing moderate- to high-intensity exercises for muscular hypertrophy and maximizing strength. Resistance-trained men showed higher arterial stiffness and lower compliance compared to the age-matched, sedentary subjects (Bertovic et al., 1999). This may impair the buffer function in resistance-trained men. However, it is unknown whether RT impairs buffer function.The purpose of this study was to examine the relationship between central arterial stiffness and cerebral blood flow pulsatility in resistance-trained men.
Methods
Thirty-one healthy men (15 resistance-trained, 21±2 years; and 16 sedentary, 23±2 years) participated in the study. Subjects were studied in resting supine position. B-stiffness index and arterial compliance were measured in the right carotid artery using a combination of applanation tonometory and brightness mode ultrasound. Pulsatility index (PI) was measured in the middle cerebral artery (MCA) using an ultrasound.
Results
B-stiffness index and PI were significantly higher in resistance-trained men compared to the sedentary subjects (B-stiffness index: 5.7±0.3 vs. 4.5±0.3; $p<0.05$, PI: 0.80±0.02 vs. 0.70±0.02; $p<0.05$). In contrast, resistance-trained subjects showed significantly lower arterial compliance than the sedentary subjects did (0.15±0.01 vs. 0.18±0.01). A positive correlation was seen between B-stiffness index and PI ($r=0.52$; $p<0.05$), and a negative correlation was seen between arterial compliance and PI ($r=-0.63$; $p<0.05$).
Discussion
The present study showed that resistance-trained men have higher arterial stiffness and PI and lower arterial compliance. In addition, arterial stiffness and arterial compliance were found to be associated with PI. Previous studies have reported that increased arterial stiffness and decreased arterial compliance with aging influence cerebral perfusion (Tarumi et al. 2011).In this study, increased arterial stiffness and decreased arterial compliance by RT were found to impair buffer function,resulting in increased cerebral blood flow pulsatility.
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Contact
nobu0902@toki.waseda.jp)

ADVANCED VASCULAR AGING IN APPARENTLY HEALTHY MALE ADOLESCENTS: THE ROLE OF CARDIORESPIRATORY FITNESS

SHERIDAN, S.E.1, GRAY, C.2, HARRISON, M.3, MURPHY, R.M.4, WONG, S.H.S.5, MOYNA, N.M.4

1:THE UNIVERSITY OF HONG KONG,2:MATER MISERICORDIAE UNIVERSITY HOSPITAL IRELAND, 3:WATERFORD INSTITUTE OF TECHNOLOGY, IRELAND,4: DUBLIN CITY UNIVERSITY, IRELAND, 5: THE CHINESE UNIVERSITY OF HONG KONG

Introduction
Carotid intima media thickness (cIMT) is a non-invasive surrogate marker for atherosclerotic cardiovascular disease (ACVD). Vascular aging (VA) evaluates cIMT measurements against race and gender matched adult cIMT data and may serve as a useful adjunct to stratify adolescents at risk of developing premature ACVD. Increased cIMT has been found in children with ACVD risk factors including low cardiorespiratory fitness (CRF). To date, no published studies have estimated VA in low fit (LF), moderately fit (MF) and high fit (HF) healthy adolescents. The purpose of this study was to estimate VA in LF, MF and HF apparently healthy male adolescents and to examine the relation between CRF and cIMT.
Methods
A total of 26 LF, 30 MF and 26 HF asymptomatic boys (mean age 15.8 ± 0.6 yr.) were randomly selected from a total of 228 boys, who underwent screening for CRF using a 20m multistage shuttle run test. VO2max was subsequently measured using open circuit spirometry during an incremental treadmill test. Following an overnight fast, a blood sample was drawn and blood pressure, body composition and pubertal development were assessed. High-resolution ultrasonography was used to measure left and right far wall intima media thickness (IMT) of the common carotid artery (CCA). Advanced VA was defined as having a mean far wall cIMT greater than or equal to the 25th percentile for race and sex matched healthy 45 year old (Howard et al., 1993).
Results
Right and left far wall cIMT was significantly higher in LF than MF ($p<0.05$) and HF ($p<0.001$) and in MF than HF ($p<0.001$). 88% of LF (n=23), 57% of MF (n=23) and 8% of HF (n=2) had advanced VA of the CCA. After adjustment for pubertal stage, blood pressure, adiposity, triglycerides and insulin resistance, there was a significant inverse relation between VO2max and right far wall cIMT ($r=-0.47$, $p=0.001$) and left far wall cIMT ($r=-0.44$, $p=0.001$).
Discussion
Compared to HF, a large proportion of LF and MF adolescents had advanced VA of the CCA. The fact that VO2max was independently related to cIMT, suggests that a low VO2max may be considered an important marker for advanced VA. Assessment of CRF may be a cost-effective way to identify adolescents at an increased risk for VA.
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Contact
sinead.sheridan2888@gmail.com

AN INVESTIGATION INTO THE PHYSICAL FUNCTION IN DDH PATIENTS DIAGNOSED WITH LEG LENGTH DISCREPANCY FOLLOWING SALTER OSTEOTOMY

LI, G.J., LIN, C.J., LIN, L.L., TSENG, W.C.
NATIONAL CHENG KUNG UNIVERSITY

Introduction
Salter osteotomy has been widely adopted for the treatment of developmental dysplasia of the hip (DDH) children by increasing the acetabular coverage and preventing future dislocation of affected hip joint. Nonetheless, some patients were evaluated with the sense of leg length discrepancy (LLD) after the surgery. Accordingly, the aim of this study is to evaluate the physical function of lower extremity and balance in DDH patients following Salter osteotomy.
Method
Twenty-five DDH patients diagnosed with leg length discrepancy caused by Salter osteotomy (age = 12.4±4.8; BMI = 18.9±3.7) participated this study. We evaluated the physical function of lower extremity by static balance test (close eyes foot balance), maximum muscular power (standing long jump), and ankle proprioception (sway index).
Results
There is no significant difference in static balance between affected leg and unaffected leg. However, the DDH patients showed poorer muscle power, flexibility, and ankle proprioception than general population by comparing with the norm in Taiwan (all under 50%).
Discussion
In general, the physical function of lower extremity in DDH patients are under the general level, although we did not observe such difference between affected leg and unaffected leg. Notably, the poorer performance of lower extremity would be indicative of lower physical function in these patients. Specifically, the sway index data may indicate decreases in position sense and threshold for movement detection the in patients with DDH. Taken together, based on these findings, DDH patients are recommended to improve lower extremity function and proprioception after Salter osteotomy.
Contact
r12055033@gmail.com

Mini-Orals

MO-PM03 Nutrition and supplements

UPREGULATION OF NICOTINAMIDE N-METHYLTRANSFERASE IN SKELETAL MUSCLE FOLLOWING PROLONGED EXERCISE AND CALORIC RESTRICTION

MARTIN-RINCON, M.1, MORALES-ALAMO, D.1, PEREZ-LOPEZ, A.2, PEREZ-SUAREZ, I.1, STRÖM, K.3,4, CALBET, J.A.1, HOLMBERG, H.C.3, HANSSON, O.4
1 IUIBS, ULPGC AND 2 UAH, SPAIN; 3 SWSRC, MID SWEDEN AND 4 LUND UNIV, SWEDEN

Introduction
Expression of Nicotinamide (NA) N-methyltransferase (NNMT), the enzyme responsible for the methylation of NA to methylnicotinamide (MNA), is reduced in obese and diabetic mice. In rodent liver, NNMT activity and plasma MNA levels are increased after 90min of swimming. NNMT knockdown in mice white adipose tissue increases energy expenditure, suggesting a protective role against diet-induced obesity and type-2 diabetes. The role that NNMT plays in human metabolism remains unknown. Thus, the aims of the study were 1) to determine in human skeletal muscle (sm) whether NNMT is upregulated by prolonged exercise and 2) to ascertain whether the expression of NNMT in sm is influenced by severe energy deficit.
Methods
Fifteen overweight men underwent to 4 days of caloric restriction (CR) (0.8 g/kg BW/day) in combination with prolonged exercise (PE) (8h walking + 45min single-arm cranking/day). Three sm biopsies (exercised/non exercised arm and one leg) were obtained before (PRE), after (PE+CR) and following 3 days of control diet (isoenergetic) and reduced exercise (CD) to measure the expression of key metabolic genes (e.g. PDK4, CPT2, PFKFB3, NNMT) (microarray), NNMT protein expression (WB) and circulating plasma MNA levels (LC-MS). Maximal fat oxidation (MFO) (indirect calorimetry) and body composition (DEXA) were measured. ANOVA repeated-measures was used.
Results
During PE+CR the energy deficit was 5000 kcal/d reducing fat mass by 2.8 (PE+CR) and 3.8 kg (CD). MFO was increased. CPT2, PDK4, PFKFB3 genes (CHO-to-fat metabolic shift) were differentially expressed (FDR<5%) in at least one sm. Compared to PRE, after CD, NNMT gene expression was upregulated in all sm (~3-5 fold). Protein NNMT increased ~13-fold ($p<0.001$), ~9-fold ($p<0.01$) and ~5-fold ($p<0.001$) for non-exercised and exercised arm (45min/day) and leg (8h/day), respectively. Circulating levels of MNA were augmented two-fold. The increase in NNMT expression from PRE to CD was associated with the increase in MFO ($r=0.37$, $p=0.01$,$n=45$).
Discussion
This findings reveal that NNMT is upregulated in human sm in response to a severe energy deficit, with a simultaneous increase of MNA plasma levels. However, this response was attenuated in the exercised sm. NNMT may have a role in facilitating fat oxidation. Caloric restriction elicits increased sirtuins expression and activity, coupled with the NAD+ breakdown into NA. Overexpression of NNMT probably prevents accumulation of NA, which would otherwise inhibit the sirtuins. Our data suggest sm as a plausible source of MNA, which may act as a myokine with a role in the adaptation to starvation.

EFFECTS OF CAFFINE INGESTION ON EXECUTIVE FUNCTION AND CEREBRAL PERFUSION

TAKAGI, Y., SATO, K., OBA, N., SADAMOTO, T., ANDO, S.
THE UNIVERSITY OF ELECTRO-COMMUNICATIONS

Introduction
In the brain, caffeine is known to act as a nonselective antagonist of A1 and A2A adenosine receptors. Caffeine increases neural activation through action on adenosine receptors, while it induces vasoconstriction and resultant decrease in cerebral blood flow. Although there are a number of studies showing that caffeine ingestion affects cognitive function, little is known how caffeine ingestion affects

executive function. Furthermore, it is unclear whether there is an interaction between alterations in executive function and alterations in cerebral perfusion. The purpose of this study was to clarify the effects of caffeine ingestion on cognitive function, cerebral perfusion, and interactions between them.
Methods
Fourteen healthy young participants (7 males and 7 females) were recruited in this study (age: 21.6 ± 0.9 yr., height: 1.66 ± 0.09 m, weight: 56.5 ± 8.6 kg). The participants performed cognitive tasks before and 20 min after either caffeine (Caffeine condition) or placebo (Control condition) ingestion. Cognitive task was a Go/No-Go task that requires executive function. We used reaction time (RT) and accuracy of the cognitive task to assess executive function. We measured internal carotid artery (ICA), vertebral artery (VA), and external carotid artery (ECA) blood flow using duplex ultrasonography immediate before each cognitive task (Sato et al. 2012). We measured mean blood flow velocity of middle cerebral artery (MCA Vmean) during the cognitive task.
Results
RT and accuracy of the cognitive task were not altered in both conditions (All Ps > 0.19), which indicates that caffeine ingestion did not affect executive function. In the Caffeine condition, ICA (-19.2 ± 10.9%, P < 0.01) and VA blood flow decreased (-16.0 ± 16.3%, P = 0.01), while ECA blood flow did not change (P = 0.72). The degree of reduction in ICA blood flow was greater than that in VA blood flow. MCA Vmean decreased after caffeine ingestion (P < 0.01). In the Control condition, ICA, VA, and ECA blood flow and MCA Vmean did not change after placebo ingestion (All Ps > 0.13). We observed no significant correlations between ΔRT and alterations in ICA, VA, ECA blood flow and MCA Vmean in both conditions (All Ps > 0.19).
Discussion
Cognitive function was not altered after caffeine ingestion. This may be due to large inter-individual differences arising from differences in caffeine sensitivity. We observed significant reductions in ICA and VA blood flow and MCA Vmean after caffeine ingestion. The greater reduction in ICA blood flow relative to VA blood flow is probably ascribed to differences in spatial distribution of adenosine A2A receptors. In contrast to ICA and VA blood flow, ECA blood flow was not reduced after caffeine ingestion. The absence of caffeine effects on ECA blood flow suggests that caffeine does not affect extracranial circulation.
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SODIUM NITRATE INGESTION INCREASES SKELETAL MUSCLE NITRATE CONTENT IN HUMANS

NYAKAYIRU, J., KOUW, I.W.K., CERMAK, N.M., SENDEN, J.M., VAN LOON, L.J.C., VERDIJK, L.B.
MAASTRICHT UNIVERSITY

Introduction
Ingestion of dietary nitrate has been shown to have vasoactive and ergogenic effects that are believed to be the result of increased nitric oxide (NO) production. Recent observations in rodents indicate that skeletal muscle tissue might serve as an endogenous nitrate reservoir. In light of the growing interest in dietary nitrate supplementation, the current study determined nitrate contents in plasma and skeletal muscle tissue in a basal post-absorptive state, and following ingestion of a single dose of sodium nitrate in vivo in humans.
Methods
Seventeen male, type 2 diabetes mellitus patients (age 72±1 y; BMI 26.5±0.5 m/kg/m2; HbA1C 7.2±0.2%) were randomized to ingest a dose of sodium nitrate (NIT; 9.3 mg nitrate per kg body weight) or placebo (PLA; 8.8 mg NaCl per kg body weight). Blood and muscle biopsy samples were taken in the basal fasted state, and up to 7 h following NIT or PLA ingestion. Plasma nitrate and nitrite concentrations, as well as muscle nitrate concentrations were measured using the gas-phase chemiluminescence technique. A repeated measures ANOVA, with time as within-subjects factor and treatment as between-subjects factor, was used to compare differences over time in plasma and muscle nitrate concentrations, and plasma nitrite concentrations between groups. Repeated measures ANOVA was also performed to assess between tissue differences (plasma vs muscle) with both time and tissue as within-subjects factor.
Results
Plasma nitrate and nitrite concentrations increased in the NIT group ($p<0.001$) following supplement ingestion, and remained higher when compared with PLA throughout the 7-h test period ($p<0.05$). Peak nitrate levels were 660±33 vs 39±3 μmol/L, and peak nitrite levels were 852±212 vs 427±53 μmol/L in NIT vs PLA, respectively. Baseline nitrate concentrations were higher in muscle than in plasma in both the NIT (57±7 vs 35±3 μmol/L) and PLA group (61±7 vs 32±3 μmol/L). Following sodium nitrate ingestion, skeletal muscle nitrate concentrations increased several fold in the NIT group (to 185±25, 169±21, and 112±12 μmol/L at t= 120, 240, and 420 min post-ingestion, respectively; time effect: $p<0.001$), and remained higher at all time points when compared with PLA (treatment effect: $p\leq0.001$).
Conclusion
In conclusion, basal nitrate concentrations are substantially higher in human skeletal muscle tissue when compared with plasma. Ingestion of a bolus of dietary nitrate strongly increases both plasma and muscle tissue nitrate contents in humans.

EFFECT OF A 9-DAY PALAEOLITHIC DIET ON ENDURANCE PERFORMANCE AND ENERGY SUPPLY

WEINGARTEN, K., BARTH, T., KRUSCHE, T., PLATEN, P.
RUHR-UNIVERSITY BOCHUM

Introduction
Effects of ketogenic diets for athletes are still hotly debated. A Palaeolithic diet (PD) is often associated with benefits in several psychological and physiological disciplines also in endurance performance (EP) [Cordain et al. 2013]. Recent studies presented changes of muscular energy supply (mES) after a low carb, high fat diet (LCHF) in elite athletes, while EP did not gain [Burke et al. 2016]. However, the effect of PD on EP is unclear so far. Aim of the study was to analyse the influence of a PD on EP and mES of healthy young recreational athletes.
Methods
A group of 11 healthy sport students (21.7 ± 1.5 yrs, 175.8 ± 10.1 cm, 71.9 ± 11.8 kg) underwent a 9-day Palaeolithic hiking trip in the rural area of Polish (d1 - d9). PD occurred for duration of 13 days (d1-d13) followed by 3 days practising carbo-loading (d+1 - d+3). During the intervention the subjects were high in fat, low in carb through the PD. Subjects were tested in a sober state 8 days before (d-8), at the end of PD (d13), and after 3 days refilling glycogen stores (d+3). EP was tested on a treadmill until exhaustion (Vmax). The 4 mmol/l blood lactate threshold (V4) and spirometry data (absolute/relative peak oxygen uptake: a/r VO2peak; respiratory exchange ratio: RER) were calculated. In addition body mass (BM) was measured. Data presented as mean ± SD.
Results

BM declined on d13 compared to d-8 (p<0.01) but normalized on d+3 (d-8: 73.8±3.2; d13: 71.1±3.1; d+3: 72.9±3.2 kg, respectively). The aVO2peak improved from d-8 to d+3 (d-8: 3534.5±255.1; d+3: 3651.2±239.1 ml/min, p<0.05, respectively) while r VO2peak peaked on d13 (p < 0.001) but remained unchanged on d+3 compared to d-8 (d-8: 47.6 ± 1.9; d13: 49.8 ± 2.0; d+3: 49.2 ± 1.5 ml/min/kg, respectively). RER decreased during submaximal exercise (< V4; d-8: 0.95±0.01; d13: 0.89±0.01, p<0.05, respectively) and on V4 at d13 (d-8: 1.0±0.01; d13: 0.96±0.01, p<0.05, respectively). RER stayed stable during exercise load higher than V4 (p > 0.05). On d+3 RER did not change compared to d-8 (p>0.05). Vmax remained unchanged on d13 and d+3 compared to d-8 (d-8: 4.49±0.22; d13: 4.48±0.17; d+3: 4.58±0.15 m/s, p<0.05, respectively).

Discussion

Our data are strongly in line with studies investigate LCHF interventions [Burke et al. 2016, Phinney et al. 1983]. Similar to elite athletes the EP of recreational athletes did not improve after a PD. The results show the ketogenic PD directed the mES towards fat oxidation indicated by lower RER and higher VO2. We found no additional benefits following PD during maximal and submaximal exercise. However, our sample did not show any negative effects undergoing a short-term PD.

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DXA LEAN MASS ARTEFACT MASKS CHANGE IN RESTING ENERGY EXPENDITURE FOLLOWING 3 WEEK LOW CARBOHYDRATE HIGH FAT DIET.

BONE, J.1,2,. ROSS, M.1,2., RYAN, M.1, BURKE, L.1,2

1) AUSTRALIAN INSTITUTE OF SPORT AND 2) MARY MACKILLOP INSITUTUE FOR HEALTH RESEARCH - AUSTRALIAN CATHOLIC UNIVERSITY

Introduction

Athletes are concerned about low energy availability and a reduction in resting energy expenditure (REE) associated with various sports-related activities. However, a correct diagnosis of such change requires confidence in the reliability of measurement of REE and the absence of artefacts that could alter the interpretation of results. We studied the effect on REE measurements when a potential artefact in DXA-derived measurement of fat free mass (FFM) caused by changes in glycogen status (1) from a low carbohydrate high fat (LCHF) diet was introduced.

Methods

Nine male race walkers were provided with a LCHF diet (<50g/d carbohydrate and >75% of energy from fat) during a 3 week training camp. Six controls underwent the same training program but followed a high carbohydrate diet (≥60% energy from carbohydrate). REE was measured by indirect calorimetry following an 8 h overnight fast. On the same morning, athletes underwent a DXA scan to determine FFM (2). Post-intervention, REE in the LCHF group was interpreted using DXA derived FFM as well as values corrected for changes in intramuscular substrate (1).

Results

REE relative to FFM in the LCHF group was 122.9 ± 2.1 and 121.5 ± 7.6 kJ/ kg FFM/d at pre and post intervention (p=0.54) respectively. When FFM was corrected for the loss of mass attributed to glycogen and fluid, REE values decreased to 117.7 ± 7.6 kJ/ kg FFM/d (p=0.03). No statistically significant change in REE was observed in the HCHO group before (128.9 ± 9.6 kJ/kg FFM/d) and after (125.9 kJ/kg FFM/d, p=0.45) the camp.

Discussion

The results from this study indicate that training on a LCHF diet is associated with a decrease in REE. This association is made evident when a correction is applied to FFM estimates to take into account that DXA-derived values are altered by the decrease in muscle glycogen (1) due to the LCHF diet (3). Failure to take into account loss of FFM from glycogen could potentially mask this change resulting in different clinical interpretations of the REE result.

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DOES MULTIDAY DIETARY NITRATE SUPPLEMENTATION HAVE AN ERGOGENIC EFFECT ON INTERMITTENT EXERCISE PERFORMANCE AND OXYGEN PARAMETERS?

APPEL, K., HÄRTER, E., STÖCKER, F., SCHULZ, T.

TECHNICAL UNIVERSITY MUNICH

Introduction

Dietary Nitrate (NO3-) supplementation has been reported to elicit many ergogenic effects in humans, for instance, to reduce the 02 cost of submaximal exercise and to increase tolerance to high-intensity exercise . Therefore, the aim of this study was to examine the ergogenic effect of NO3- supplementation via beetroot on exercise performance (power output, repeated sprint ability) and oxygen parameters during a session of high intensive sprint interval training (SIT).

Methods

Thirteen healthy, recreationally active men (aged 17-34 yrs, VO2peak 51.77 ± 5.80 ml/min/kg) participated in this study. In a randomized, double blinded, crossover design subjects received either NO3- rich (70ml/day, containing 0.4 - 0.45 g of NO3-) or depleted (70ml/day, containing <1.26 mg of NO3-) beetroot juice for a six day period. On day six, the subjects completed a SIT test consisting of 3-5 x 30 seconds „all out" cycling sprints interspersed by four minutes of passive recovery. Power output (Pmean, Ppeak), blood lactate and oxygen uptake (VO2) were recorded. Relative changes in oxygenated (ΔO2Hb) and deoxygenated (ΔHHb) hemoglobin were calculated using near-infrared spectroscopy (NIRS) of the left vastus lateralis muscle.

Results

Compared to placebo (PL), nitrate supplementation (BR) elicited higher mean and peak power output (Pmean BR: 625.00 ± 78.16 vs. PL: 609.13 ± 82.12 W; Ppeak: BR: 936.05 ± 129.16 vs. PL: 905.21 ± 117.33 W, both p>.05), while none of the enhancement between sprints was statistically significant. The decrease of power was significantly attenuated in between the 1st and 2nd interval by nitrate (BR: 16.6 ± 5.6% vs. PL: 18.9 ± 6.3%; p<.05), whereas the decline within each interval did not change (p<.05). Oxygen uptake during sprints was slightly elevated in BR (46.16 ± 5.91; 48.96 ± 5.26; 47.78 ± 4.56 ml/min/kg) compared to PL (44.39 ± 7.13; 46.20 ± 6.98; 45.00 ± 5.78 ml/min/kg; p >.05). Muscle oxygenation (Δ HHb, Δ O2Hb), as well as metabolic response (lactate) remained unchanged between conditions in the three subsequent SIT.

Discussion

The trends in power output support the beneficial effects of nitrate supplementation on performance, as well as the higher repeated sprint ability after the first two intervals. The lack of effect in muscle oxygenation corresponds to actual research, as well as the statistically non relevant changes in VO2. Dietary Nitrate (NO3-) supplementation seems to have an effect on repeated sprint ability in SIT and may therefore result in enhanced training adaptions and higher performance improvement in long term. Nevertheless, this change can not be explained by oxidative or metabolic processes. There might be other factors influencing intermittent exercise performance more, e.g. cognitive parameters.

Contact

katharina.appel@web.de

IMPACT OF A PROTEIN-BASED NUTRITIONAL SUPPLEMENT UPON DIETARY BALANCE IN TRAINED GAMES PLAYERS

ELLMORE, M.

UNIVERSITY OF LINCOLN

Introduction

Amongst the athletic community, intake of nutritional supplements is widespread which has led to a significant number of experimental studies seeking to determine the ergogenic effect of such products. Most investigations fail to evaluate the impact of the supplement or placebo constituents upon participants' dietary status which may result in misleading interpretations if the ingredients serve to optimise nutritional balance rather than directly improve performance. The purpose of this research was to examine dietary intake of trained games players after consumption of a lactose placebo and a whey protein/creatine supplement.

Methods

Trained games players were recruited as respondents to a supplementation survey (n=15, M ±sd Body mass: 80.4kg ±7.7, Age: 23.2 years ±3.8) which indicated that ~13% of athletes took the same named whey protein/creatine product (Airstone et al. 2005). Players completed 7 day weighed food diaries and consumed 1.2g/kg/day supplement or placebo using a double-blind, crossover design for eight weeks. Dietary intake was evaluated using Microdiet® and players' dietary intake was compared using a dependent t-test (p<0.05) adapted using the Bonferroni correction for consideration of each nutritional component (p<0.01).

Results

Players' normal dietary calorie intake was the same in placebo and supplement phases of the investigation (p=0.184). Significant differences were evident in energy, carbohydrate, fat and protein intake between the participants' normal diet, diet plus supplement content and diet plus placebo content (p<0.001). In comparison to athletic recommendations, the players' normal diets were deficient in carbohydrate, energy and protein (p<0.01) and although the protein recommendations were exceeded during supplementation, energy and carbohydrate needs were still not met.

Discussion

When using similar methods for dietary recording, previous research has shown that games players report intakes which were similar to those found in this study and were insufficient in relation to athletic norms. This evidence contributes to the area of nutritional supplement investigation and emphasises the need for future research to incorporate dietary analyses under supplement and placebo conditions. Supplementing athletes should be cautious about interpreting ergogenic effects as benefits reported may not be consequent to active ingredients but rather due to the constituents of the supplement or placebo compensating for existing dietary deficiencies.

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EFFECTS OF DIETARY NITRATE ON PHYSIOLOGICAL RESPONSES, COGNITIVE FUNCTION, AND EXERCISE PERFORMANCE AT SIMULATED HIGH AND VERY-HIGH ALTITUDE

SHANNON, O.M.1, DUCKWORTH, L.1, BARLOW, M.J.1, DEIGHTON, K.1, MATU, J.1, WILLIAMS, E.1, WOODS, D.1, STEPHAN, B.2, SIERVO, M.2, O'HARA, J.P.1

1: LEEDS BECKETT UNIVERSITY (UK), 2: NEWCASTLE UNIVERSITY (UK)

Introduction

Nitric oxide (NO) bioavailability is reduced during acute altitude exposure, contributing towards the decline in exercise performance and cognitive function in this environment. This study evaluated the effects of nitrate (NO3-) supplementation on NO bioavailability, exercise performance, and cognitive function at high and very-high simulated altitude.

Methods

Ten males (VO2max: 60.9±10.1ml/kg/min) rested and performed exercise twice at 3,000 m (~14.0% O2) and twice at 4,300 m (~11.7% O2) simulated altitude. Participants ingested either 140ml concentrated NO3- rich (BR; ~12.5mmol NO3-) or NO3- deplete (PL; 0.01mmol NO3-) beetroot juice 2h before each trial. Participants rested in a normobaric hypoxic chamber for 45min prior to and following an exercise task. Exercise comprised a 45min walk at 30% VO2max and a 3km time-trial (TT), and was conducted on a treadmill at a 10% gradient whilst carrying a 10kg backpack to simulate altitude trekking. Plasma nitrite concentration ([NO2-]), arterial oxygen saturation (SaO2), pulmonary oxygen uptake (VO2), muscle and cerebral oxygenation, and cognitive function were measured throughout.

Results

Pre-exercise plasma [NO2-] was significantly elevated in BR compared with PL (BR-3000m: 630.9±253.7, PL-3000m: 203.9±70.6, BR-4300m: 555.3±171.9, PL-4300m: 238.3±125.3nM; main effect of supplement, p=0.001). Pulmonary VO2 was reduced (BR-3000m: 17.2±3.9, PL-3000m: 18.1±3.9, BR-4300m: 17.6±4.0, PL-4300m: 18.5±4.2ml/kg/min), and SaO2 was elevated (BR-3000m: 84±2, PL-3000m: 80±6, BR-4300m: 72±5, PL-4300m: 70±5%) during steady-state exercise in BR compared with PL (main effects of supplement, all

p≤0.020), with similar effects at both altitudes. BR supplementation enhanced 3km TT performance relative to PL by 3.8% (1653.9±261.3 vs 1718.7±213.0s) and 4.2% (1809.8±262.0 vs 1889.1±203.9s) at 3000m and 4300m, respectively (main effect of supplement, p=0.019). Oxygenation of the gastrocnemius was elevated during the TT consequent to BR (BR-3000m: 49.0±13.1, PL-3000m: 39.9±12.8, BR-4300m: 46.2±13.0, PL-4300m: 36.5±14.6%; main effect of supplement, p=0.011). Cognitive function did not differ significantly between BR and PL at rest or during exercise (all p≥0.056).
Discussion
This study suggests that BR elevates arterial and muscle oxygenation, reduces VO2, and enhances TT performance by a similar magnitude during trekking at high and very-high simulated altitude. Conversely, BR did not significantly influence cognitive function. These findings have important practical implications for individuals ascending to altitude for trekking purposes.
Contact
O.Shannon@LeedsBeckett.ac.uk.

Mini-Orals

MO-PM02 Training and testing: endurance

EFFECTS OF TOPOGRAPHY, ROAD GRADIENT AND RIDER SPECIALITY ON MAXIMAL MEAN POWER OUTPUT DURING PROFESSIONAL CYCLING

METCALFE, A.J.1, VILLERIUS, V.2, PEIFFER, J.J.3, MENASPÀ, P.1, QUOD, M.4, ABBISS, C.R.1

1: ECU (PERTH, AUSTRALIA), 2: CPCT (FRANCE), 3: MU (PERTH, AUSTRALIA), 4: OSPCT (AUSTRALIA)

Introduction
Cycling power output may be influenced by rider specialisation (Sallet et al. 2006), topography (Vogt et al. 2007) and road gradient (Nimmerichter et al. 2012). However, little is known with regards to the maximal power output achieved by professional cyclists during competition. Therefore, the primary aim of this study was to examine if maximal mean power outputs (MMP) differ across various topographies, road gradients and rider specialities within grand tour cycling events. The secondary aim of this study was to determine if the percentage of race time spent in different power output bands differs between categories of topography, rider speciality and road gradient.
Methods
Power output was collected from 13 professional male cyclists during a total of 229 mass start stages of three grand tour cycling events between 2011 and 2015. The MMP obtained for 5, 15, 30, 60, 300, 600, 1200, 1800, 2400 and 3600 s were compared between stages of varying topography (flat (n=104); semi-mountainous (n=57); mountainous (n=68)) and between riders of differing specialities (domestiques (n=5); climber (n=4); sprinter (n=2); general classification (n=2)). The proportion of race time spent in eleven power bands, ranging from less than 0.75 to greater than 7.5 W·kg-1, was compared between categories of topography, rider speciality and road gradient (<0%, 0 to 5% and >5%).
Results
MMP for durations greater than 1200 s were higher in semi-mountainous and mountainous stages, when compared with flat stages (1200 s: 5.1 ± 0.2, 5.2 ± 0.3, 4.5 ± 0.3 W•kg-1 respectively; P <0.05). Sprinters and climbers spent greater percentage of race time at a power output greater than 7.5 W•kg-1, when compared with general classification riders and domestiques (11.3, 11.4, 7.1 and 5.3%, respectively; P <0.05). A greater proportion of race time was spent at a power output above 3.7 W•kg-1 when cycling at a road gradient greater than 5% (P <0.05), compared with road gradients 0 to 5% and less than 0%.
Discussion
Topography, gradient and rider speciality influence the MMP values observed during grand tour races. Caution should be taken when comparing MMP values between cyclists of differing speciality or when obtained from races of varying topography. These results have implications for calculations that may rely on MMP values, such as the estimation of critical power.
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IMPACT OF TYPES OF 400 KILOMETER MILITARY MARCH TRAINING ON LOWER LIMB FUNCTION AND MENTAL STATES IN KOREAN SPECIAL FORCE SOLDIERS

SUNG, B.

KOREA INSTITUTE OF SPORT SCIENCE

Introduction
Military march gives rise to considerable risk to soldiers combat capacity, physical health, and mental readiness. This study examined the impact of three types of annual training of 400 km military march (400K) of Korean Special Force soldiers on knee function and mental states.
Methods
Ninety six Korean Special Force soldiers (25.5±3.7 yrs; 176.8±5.0 cm; 72.5±5.9 kg; 43.0±33.2 month of military career) participated in 400K. They were randomly assigned into one of 3 march types differing schedules; traditional march (TM; n=15; 6×50-rest-100 km), late stage 100 march (L100K: n=49; 3×50-rest–3×50-rest-100 km), early stage 100 march (E100K; n=32; 100-rest-3×50-rest-3×50 km). Before and after the march, knee function was assessed by questioning 8 lower body functions; limping, supporting, stair climbing, sitting down, instability, pain, swelling, and thigh tightness. Mental Toughness was evaluated with subscale of competitiveness, hard fighting, patience, and fighting spirit. Knee function and Mental Toughness were calculated and scored. Perception toward 400K was assessed by 3 open questions in 5 point Likert scale.
Results
Total score of knee function was 93.7±14.8 and 97.7±2.6 in TM, 84.7±19.6 and 85.0±20.1 in L100K, and 80.7±14.6 and 81.4±15.9 in E100K, before and after 400K (p>0.05). Mental Toughness increased from 3.8±0.6 to 4.2±0.7 by 400K in L100K, but decreased from 4.2±0.5 to 3.8±0.7 in E100K. Mental Toughness after 400K was significantly different between L100K and E100K (p<0.005). Mental Toughness of TM

was not different after 400K. Positive perception toward 400K was 3.8±0.7 and 3.9±0.7 in TM, 3.2±1.1 and 4.0±1.0 in L100K, and 4.2±0.7 and 3.1±0.9 in E100K, before and after the 400K, respectively. The perception after the 400K was higher in TM and L100K than E100K ($p<0.005$).
Discussion
Physical and mental injury rates of soldiers during training sessions are a major concern in the special forces. Traditional 400 km march of Korean Special Forces allowed only one resting day while L100K and E100K did for two resting days. Any three types of marching schedule did not change knee function. However, the number of days of resting and the march distance indeed affected the mental status of the soldiers. The findings of this study are valuable for developing and implementing long duration military march. Practical application and strategy development should be considered.
Contact
bjsung@sports.re.kr

EFFECTS OF SIX WEEKS SPEED ENDURANCE TRAINING WITH TREADMILL ON HURDLE ATHLETE'S PERFORMANCE

TIEN-NING, T.
UNIVERSITY OF TAIPEI

Introduction
Hurdle is a sprint project and all the hurdlers hope could complete whole duration with top speed. Speed endurance not only a capability of speed maintenance during whole competition, but a capacity of hurdling. And the curve of speed could shows the capacity of speed maintenance of hurdler. To investigate the effects of treadmill training in hurdles players for stride length, stride frequency and speed endurance. As the skill enhance, speed and endurance training are more importance to hurdle.
Methods
The training intensity started from 75% of each subject's maximum speed , 12 subjects (20.22 ± 1.31 years old) for 6 weeks speed endurance training, the training schedule was 3 times in a week.
Results
There was significant increased between pre- and post-test on sit and reach (37.500 ± 5.943 cm vs. 42.833 ± 6.544 cm), eyes-closed with insole balance test (1.808 ± 0.306 vs. 1.580 ± 0.489), counter movement jump (35.573 ± 5.339 cm vs. 39.440 ± 6.171 cm), anaerobic capacity (9.200 ± 1.192 W vs. 9.600 ± 1.156 W), T-agility test (11.660 ± 0.799 s vs. 11.042 ± 0.754 s), stride frequency of hurdles of 400mH (258.600 ± 9.762 vs. 245.600 ± 7.570) and speed of hurdles of 400mH ($p<.05$).
Discussion
After 6 weeks speed endurance training we could find out on there were no significant improved in 100mH and 110mH's performance. But, lower limb's muscular strength, power, stride frequency, and time between hurdles in 400mH were significant improved.
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FACTORS THAT IMPROVE THE ENDURANCE RUNNING PERFORMANCE IN ELEMENTARY SCHOOL BOYS IN JAPAN

NAKATSUKA, H.1, TAKEDA, Y.1, YAMASHITA, H.1, MORI, H.2, YAMAMOTO, M.3
1: ARROWS LAB (JAPAN), 2: RITSUMEIKAN UNIVERSITY (JAPAN), 3: NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA (JAPAN)

Introduction
In recent years, it has become apparent that Japan facing a decline in aerobic capacity among the younger population. For example, a study conducted in Japanese elementary and junior high school children (Ito et al., 2011) showed that the running distance for five minutes was lower in children from 2005 as than in children from 1986. Therefore, the purpose of our study was to determine the relationship between endurance running performance and aerobic capacity (maximal oxygen uptake: VO2 max, velocity at ventilatory threshold: vVT, running economy: RE) of elementary school boys, regarding their development and growth parameter (height).
Methods
Ninety-three healthy elementary school boys participated in this study. The participant's training or exercising habits involved exercising for more than one session per week. Endurance running performance was evaluated according to running velocity at VO2 max (vVO2 max) which was measured using an incremental running test on a motor driven treadmill. Similarly, VO2 max, vVT, and RE were measured using the incremental running test. We analyzed the relationship between chronological age and aerobic capacity via partial correlation analysis (control value was height) taking into account the effect of their growth.
Results
The vVO2 max showed correlation with VO2 max, vVT, and RE. The chronological age correlated with VO2 max (L・min-1), vVT, and RE without VO2 max (mL・kg-1・min-1). Partial correlation analysis revealed that the subject's chronological age was significantly related to vVO2max, vVT, and RE independent of VO2 max (L・min-1 and mL・kg-1・min-1).
Discussion
The contributing factors for improving endurance performance of elementary school boys are VO2 max, vVT, and RE. Furthermore, the relationship between growth parameters and measures of aerobic capacity suggests that vVT and RE increase with the growth related increase in vVO2 max. With regards to their development and related increase in height, the subject's endurance performance can be attributed to vVT and RE (i.e. qualitative changes) rather than their VO2 max (i.e. quantitative changes). Thus, we suggest that to improve endurance performance of elementary school boys, a program targeting the improvement of vVT and RE needs to be established.
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Contact
nakatsuka@ajk.jp

THE STRESS OF BACKPACKING

THYS, S., HECKMANN, B., WILHELM, K., SCHAAR, B.
UNIVERSITY OF THE GERMAN ARMED FORCES

Introduction
Individual travel with backpacking has become a trend. Not infrequently 15 kg or more are carried on the back over longer distances. The aim of this study is to determine the stress from an additional load on the ventilatory thresholds.
Methods
The study was conducted with 15 physically powerful male students aged 23 to 28 years ($\bar{x}$ = 24.9 years, SD = ± 1.22 years). The body size was 1.69 m to 1.94 m ($\bar{x}$ = 1.79 m, SD = ± 0.07 m). The body weight was between 59 kg and 99 kg ($\bar{x}$ = 76.47 Kg, SD = ± 9.48 Kg). The BMI ranged from 20.6 kg / m² to 26.2 kg / m² ($\bar{x}$ = 23.8 kg / m², SD = ± 1.47 kg / m²). Bruce (modified) tread tests were performed with spiroergometric analysis and lactate diagnostics at two measurement times. The first test was carried out with an additional load of 16 kg by a backpack, the second without additional load.
Results
At the ventilatory thresholds VT1 and VT2, significant different running speeds and oxygen intake could be detected. The maximum measured oxygen consumption VO2 peak is reduced by the additional load. Lower running speeds can be achieved.
Discussion
Of this impact, a training adjustment has to be done in order to prepare for long backpacking trips. The basis of the training should be a spiroergometric measurement. Important is a special adapted aerobic endurance training and not only a strength training for travel with backpacking (Knapik et al. 2012).
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INFLUENCE OF TRAINING INDUCED-FATIGUE ON PERFORMANCE INDICATORS IN CYCLISTS

SCHWINDLING, S., SKORSKI, S., PFEIFFER, M., FERRAUTI, A., KELLMANN, M., MEYER, T.
SAARLAND UNIVERSITY

Introdcution
Performance testing can interfere with an athlete's training schedule by the necessity of complete recovery prior to the test. Due to a nature of elite athletes training regimes, it remains unsure whether complete recovery is ever achieved. Thus, target parameters, which are independent from recovery status of an athlete, appear attractive. Therefore, the aim of this study was to detect the influence of training-induced fatigue on established maximal and submaximal performance indicators determined.
Methods
23 trained cyclists (29 ± 8 y, 180 ± 6 cm, 74 ± 8 kg, VO2max 59.4 ± 7.4 ml/min/kg) completed a 6-day highly fatiguing training camp. Before, directly after the camp and after 2 days recovery (no exercise, no specific interventions) they performed a 40-km-time-trial (TT), a 30-second-Wingate-Sprint (WT) and a stepwise incremental test until exhaustion (IXT). The lactate thresholds (LT) were calculated according to the concepts of Stegmann et al. (1981), Dickhuth et al. (1991), Dmax (Cheng et al., 1992) and 4-mmol (Mader et al., 1976) on the basis of measurements during IXT. All tests were performed on the same day with 2 hours separating them. Statistical testing for significant effect on performance and strain parameters was conducted by means of a repeated measured ANOVAs and post hoc Scheffé testing.
Results
Overall TT performance (TT1: 3942 ± 212 s; TT2: 4008 ± 201 s; TT3: 3929 ± 219 s), WT mean power output (701 ± 58 W; 679 ± 65 W; 696 ± 69 W) and the maximal power output in IXT (338 ±30 W; 327 ± 31 W; 347 ± 30 W) were significantly reduced after the training camp ($p < 0.01$) and increased after 2 Days of recovery ($p < 0.01$). The entire course of lactate values from IXT was not different between test days ($p = 0.16$). No changes were found for LTDickhuth (268 ± 32 W; 265 ± 30 W; 270 ± 33 W; $p = 0.34$) and LT4-mmol (295 ± 34 W; 295 ± 31 W: 297 ± 33 W; $p = 0.69$). LTStegmann was significantly higher 2 days post (270 ± 28 W; $p = 0.03$) compared directly after the training camp (264 ± 30 W). Dmax was significantly reduced directly after the training camp (256 ± 27 W) compare with before (265 ± 29 W; $p < 0.01$) and after 2 days of recovery (269 ± 29 W; $p < 0.01$).
Discussion
The study indicates that there is no influence of accumulated fatigue over several days without glycogen depletion on the submaximal lactate thresholds according to Stegmann, Dickhuth and 4-mmol in cyclists. The Dmax-threshold however seems to be responsive to such short-term fatigue. This is in agreement with a negative fatigue effect on maximal physiological measurements, which are relevant for Dmax determination.

IMPACT OF ENDURANCE EXERCISE IN HYPOXIA ON ACID-BASE BALANCE AND POTASSIUM KINETICS

SUMI, D., KOJIMA, C., KASAI, N., GOTO, K.
RITSUMEIKAN UNIVERSITY

Introduction
Training in hypoxia has been widely utilized to improve exercise capacity, whereas the mechanism behind improved exercise capacity remains unclear. In the present study, we determined acid-base balance and potassium kinetics during exercise and post-exercise under moderate hypoxic condition in endurance athletes.
Methods
Nine trained middle-long distance athletes completed two different trials on different days, consisting of exercise in moderate hypoxia (H, FiO2:14.5%) and exercise in normoxia (N, FiO2:20.9%). They performed interval type of endurance exercise (8×4-min pedaling at 80% of VO2max separated with 2-min of active rest at 40% of VO2max) under hypoxic or normoxic conditions. Venous blood samples were obtained before exercise, and during exercise and post-exercise periods. Data for expired gases and heart rate (HR) were collected during exercise.
Results
The blood lactate concentrations during exercise and post-exercise period were significantly higher in the N trial than in the H trial ($p = 0.012$). Bicarbonate ion concentrations ($p = 0.001$) and blood pH ($p = 0.019$) were significantly lower in the N trial than in the H trial. The N

trial revealed a significantly greater exercise-induced elevation of blood or serum potassium concentrations than did the H trial (p = 0.03). The expired minute ventilation (VE) and HR during exercise was higher in the N trial than in the H trial (p = 0.001).
Discussion
The augmented potassium response in the N trial was observed with concomitant lower pH during the exercise, which corresponded with a previous finding (Davies et al. 1990). It has been assumed that exercise under hypoxic condition would elicit the elevation of blood lactate concentrations and decline of pH (Buccheit et al. 2014), but these hypotheses were not supported by the present findings. Moreover, difference of absolute exercise intensity between two conditions was larger compared with previous study using similar hypoxic condition and exercise intensity (Friedmann et al. 2004). Therefore, caution is required for interpretation of the results because absolute exercise intensity was markedly lowered in the present H trial to match relative exercise intensity. In summary, high-intensity interval exercise on a cycle ergometer under moderate hypoxic conditions did not elicit decline of pH and potassium elevation compared with an equivalent level of exercise under normoxic conditions.
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Contact
sh0034vr@ed.ritsumei.ac.jp

THE RELATIONSHIP BETWEEN TIMING OF ENDURANCE EXERCISES AND PHYSIOLOGICAL RESPONSES DURING EVENING AND NIGHT-TIME SLEEP

NISHIMURA, K., YAMAGUCHI, H., NAGASAKI, K., ONODERA, S., TAKAMOTO, N.
HIROSHIMA INSTITUTE OF TECHNOLOGY

Introduction
This study aimed to examine the effects of endurance exercises performed in the evening on physiological responses during evening and night-time sleep.
Methods
The study included six healthy men who provided written informed consent before participation. The study was performed under two conditions: the 17h-condition and the 21h-condition. In the 17h-condition, the participants performed cycling exercises for 30 min at 17:15. In the 21h-condition, the participants performed cycling exercises for 30 min at 21:15. The exercise intensity was adjusted to 50% of maximum oxygen uptake in both conditions. All participants went to bed at 23:00 and woke up at 07:00 in each experimental condition. In the evening, heart rate (HR), cardiac autonomic nervous system modulation (ANS), blood pressure (BP), and oral temperature were measured in both conditions. During night-time sleep, HR, BP, and ANS were measured, and actigraphy was performed in both conditions. Each participant had breakfast at 07:30, lunch at 12:30, and dinner at 19:30 in both conditions. Participants were allowed 10 min to eat their meals and were not allowed to eat or drink anything other than what was provided. On the day the measurements were taken, participants were not allowed to nap; however, they were instructed to restrict physical activity to a minimum by engaging in physically undemanding activities such as reading a book or attending a lecture while seated.
Results
The participants' mean HR during endurance exercise was 126.8 ± 6.0 bpm. There were no significant differences in HR between the two conditions. In the evening, HR and ln HF (index of cardiac parasympathetic nervous system modulation) were significantly different in the both conditions. There were no significant differences in BP and oral temperature in the evening between the two conditions. During night-time sleep, sleep efficiency and delta subjective sleepiness were significantly lower in the 21h-condition than in the 17h-condition. The HR during night-time sleep was significantly lower in the 21h-condition than in the 17h-condition. There were no significant differences in the amount of uninterrupted sleeping, BP, and ANS during night-time sleep between the two conditions.
Discussion
Our results show that endurance exercise before night-time sleep might be a factor of exacerbated sleep. In the future, and based on the findings of our study, efficient sleep may be promoted by regularly performing endurance exercise earlier in the evening. In conclusion, sleep efficiency and delta subjective sleepiness may be affected by the timing of endurance exercises.

Mini-Orals

MO-BN01 Neurophysiology and motor learning

EFFECTS OF ACUTE AEROBIC EXERCISE ON EXECUTIVE FUNCTION: AN FMRI STUDY

KOBAYASHI, A., SENOO, A., FUJITA, G., MIZUGUCHI, N., KAMIJO, T., MARUYAMA, K., TAKIGAWA, R., OHKAWARA, K., ANDO, S.
THE UNIVERSITY OF ELECTRO-COMMUNICATIONS

Introduction
There is a growing body of evidence to show that acute aerobic exercise improves executive function. Nevertheless, it remains largely unknown how acute exercise alters neural activity related to executive function. Hence, the purpose of this study was to identify brain areas that are associated with cognitive improvements using functional magnetic resonance imaging (fMRI). We hypothesized that acute exercise alters functional pattern of brain activity associated with executive function.
Methods
Nine healthy right-handed young men participated in this study (age: 21.8 ± 1.2 yr., height: 1.72 ± 0.04 m, weight: 70.2 ± 10.9 kg, peak oxygen uptake (VO2peak): 48.8 ± 8.8 ml/kg/min). The participants performed cognitive tasks in the Exercise and Control conditions in a counterbalanced order. The cognitive task was a Go/No-Go task (Watanabe et al., 2002) that requires executive function. We measured reaction time (RT) and accuracy of the Go/No-Go task to assess executive function. In the Exercise condition, they performed the cognitive task before and after exercise at 40% VO2peak for 30 min. In the Control condition, they performed the cognitive task before and after the resting period of 30 min. We applied an event-related fMRI to identify brain areas that was activated during the cognitive task and detect-

ed significant changes in MR signals in relation to the Preparation phase, Go responses and No-Go responses. We analyzed fMRI data using Statistical Parametric Mapping 12.
Results
We observed that RT decreased after acute exercise in the Exercise condition ($p < 0.05$), while it did not change in the Control condition. In contrast, accuracy of the cognitive task was not altered in both conditions. In the Exercise condition, acute exercise specifically activated the anterior cingulate cortex and the inferior frontal gyrus during the GO responses ($p < 0.01$, respectively). Furthermore, the degree of activity changes in the anterior cingulate cortex during the GO responses was negatively correlated with ΔRT in the Exercise condition ($p < 0.01$).
Discussion
RT in the cognitive task decreased without sacrificing accuracy. Thus, cognitive improvements observed in the present study was ascribed to physiological alterations induced by acute aerobic exercise. We identified that acute aerobic exercise specifically activated the inferior frontal gyrus and the anterior cingulate cortex which are thought to be related to executive function (Cai et al. 2016). Furthermore, negative correlation between the degree of activity changes in the anterior cingulate cortex and ΔRT suggests that the anterior cingulate cortex may play a crucial role in the improvements of response speed by acute exercise.
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Contact
K1632038@edu.cc.uec.ac.jp

NEURAL DECODING OF MUSCLE SYNERGY ACTIVATIONS FROM EEG SIGNALS IN HUMAN WALKING

YOKOYAMA, H.1, OGAWA, T.1, KAWASHIMA, N.2, NAKAZAWA, K.1
1. THE UNIVERSITY OF TOKYO, 2. RESEARCH INSTITUTE OF NATIONAL REHAB. CENTER (JAPAN)

Introduction
The spinal cord is recognized as the center of locomotor control in vertebrates. However, during walking in human subjects, the cortex is majorly involved, as revealed by recent neuroimaging techniques[1]. Spectral power of cortical activity is modulated during the gait cycle1. Nevertheless, the mechanism by which cortical signals control muscle activity during walking remains unclear. As for muscle activity, the central nervous system may control walking using muscle synergies (synchronous activation of muscles) via hierarchical neural pathways[2]. Here, we tested the following hypothesis: if the cortex contributes to the control of locomotor muscle synergies, activations of muscle synergies should be decoded from electroencephalogram (EEG).
Methods
EEG (31ch, sensorimotor area) and electromyogram (EMG, 15 leg muscles) were recorded from 13 healthy men who walked on a treadmill (0.6 m/s, 7 min). Muscle synergies were extracted from the EMGs using nonnegative matrix factorization. Artifacts were removed from the EEG signals using artifact subspace reconstruction. From the cleaned EEGs, we computed the spectral power in three frequency bands [α (8–13 Hz), β (14–20 Hz), and γ (21–40 Hz)]. Then, neural decoders, which predict muscle synergy activations from the brain signal (spectral power) inputs, were designed and optimized using partial least squares regression. For accuracy evaluation, correlation coefficient (r) was calculated between the original and predicted activations. Contributions of electrode locations and frequencies to the decoding were evaluated based on weightings of the model. In addition to the muscle synergy decoders, we designed EMG decoders.
Results
Activations of muscle synergies and EMG were decoded from EEG signals. The accuracy of the synergy decoder was higher than that of the EMG decoder [$p < 0.05$, synergy: $r = 0.32 \pm 0.024$ (mean±SE), EMG: $r = 0.28 \pm 0.021$]. The three electrodes over the leg motor area made large contributions to the decoding ($p < 0.05$, compared to median of all electrodes). Contribution of the α-band activity was larger than those of the β and γ bands ($p < 0.05$).
Discussion
Our decoding results suggest that cortical signals contain the control commands of locomotor muscle activity. The higher accuracy of the synergy decoder than that of the EMG decoder suggests hierarchical neural control of muscle activities through muscle synergies. The high contribution of α band activity in the leg motor area may be associated with a large modulation of that activity during active walking compared to passive walking[1]. Our work is a further step toward the understanding of human locomotor control and brain-computer interface technologies for improving gait rehabilitation.
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INFLUENCE OF MENTAL LOAD ON VOLUNTARY ACTIVATION DURING REPETITIVE LOW-INTENSITY THUMB TRACKING TASK

STEINHILBER, B., GAILLARDIN, F., BAUDRY, S., DUCHATEAU, J.
UNIVERSITY HOSPITAL TUEBINGEN AND UNIVERSITÉ LIBRE DE BRUXELLES

Introduction
Little attention has been given to the influence of mental loads on physical performance (dual-task effect) during repetitive tasks in the field of industrial occupations. Metha and Agnew (2012) reported lesser reductions in maximal voluntary contraction (MVC) strength after intermittent isometric shoulder abduction (15, 35 and 55% MVC) performed alone than combined with a mental task. Such a dual-task effect could reflect fatigue-related changes within the nervous system, including greater reduction in the capacity to voluntary activate muscle. Thus this study investigated the influence of mental load during repetitive movements performed with the thumb on voluntary activation.
Methods
Twelve subjects participated in two dual-task sessions on separate days in counterbalanced order. Both sessions included the same motor task combined with either an easy or difficult mental task. The motor task consisted of tracking a template – involving shortening, isometric and lengthening contractions – by lifting a load (10% of the maximal strength) with the thumb adductor muscles for 45 min. During the easy mental task subjects counted forward by 1, whereas they counted backward by steps of seven and thirteen in the difficult

mental task. The torque produced by the thumb adductor muscles during MVC was measured before, during (every 5 min), and directly after the dual-task. Rate of perceived exertion (RPE) and mental demand (Nasa TLX) were recorded every 5 min during the dual-task.
Results
Changes in MVC torque (~20% decrease) were similar in the two dual-task conditions (easy and difficult mental tasks). However, RPE and Nasa TLX were lower and increased less during the easy mental task session.
Discussion
Compared with previous work reporting increased fatigability during difficult dual-task condition (Metha and Agnew 2012; Yoon et al. 2009), our results indicate that mental demand did not interfere with mechanisms involved in neuromuscular fatigue. Such a difference may be explained by the muscle involved in the task, the absence of failure at the end of the task or the lower intensity used in the present study. Nonetheless, this study suggests that the magnitude of the mental demand did not seem to interfere with the level of voluntary activation during the time course of the trial.
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Contact
Benjamin.steinhilber@med.uni-tuebingen.de

TEACHING POSTURAL PERFORMANCE AND SELF-PERCEPTION IN HANDSTANDS. DOES THE FEEDBACK STRATEGY MATTER?

ROHLEDER, J., VOGT, T.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
With numerous studies addressing the effect of different feedback strategies on motor behaviour, applied methods focusing on sport-specific movement techniques remain to be elucidated. With respect to handstand characteristics as a basic gymnastic skill, recent studies examined balancing processes; however, only little research dealt with imparting this skill to gymnast novices. Thus, this study compared two feedback strategies (i.e. visual-comparative, VC and tactile-verbal, TV) on handstand acquisition, according to changes in postural performance and self-perception.
Methods
Twenty-four sport students (17 males, 7 females), divided into two groups, randomly received one of the two different feedbacks (each group n=12; group VC: age 22.2 ± 1.9 years, height 176.6 ± 9.9 cm, weight 70.7 ± 14.2 kg; group TV: age 22.2 ± 3.6 years, height 181.0 ± 9.7 cm, weight 73.6 ± 10.2 kg). Prior to and immediately after feedback each participant performed three handstands. Postural performance was captured via video recordings, whereas a motion-doll was used to collect self-perception data. With respect to a guiding handstand model, a goniometric analyses focussing on shoulder, hip and head positions was conducted to examine the effects of the feedbacks.
Results
After VC feedback, in the shoulder angle self-perception improved ($p<0.05$; pre: 14.20±7.92; post: 8.20±3.92), whereas a tendency of improved postural performance failed significance ($p<0.10$; pre: 20.97±9.38; post: 18.53±7.55). For TV feedback, in the shoulder angle postural performance improved ($p<0.01$; pre: 19.38±9.80; post: 15.13±10.15), whereas no significant change was revealed for self-perception ($p>0.05$; pre: 13.83±6.21; post: 12.33±10.26). Changes in all other joint angles were statistically not modulated by feedback ($p>0.05$).
Discussion
The present findings for handstand performance (i.e. TV) and self-perception (i.e. VC) in the shoulder angle are in line with previous research suggesting verbal and tactile advices to assist motor learning in gymnastics. With TV feedback supporting a transfer of sensory information to movement planning, VC feedback supports visuomotor processes to improve short-term handstand acquisition. To conclude and with respect to the intended educational objective, combined or selected feedback strategies may be suggested to improve postural performance and/or self-perception when teaching the handstand.

THE DIFFERENCES OF ADAPTABILITY AMONG ACQUIRED PATTERNS IN LEARNING TO JUGGLE

YAMAMOTO, K., SHINYA, M., KUDO, K.
THE UNIVERSITY OF TOKYO

Introduction
Sports tasks often have redundancy in how to solve task problems, according to this redundancy, the learner can acquire various patterns in the learning process as individual form. It was reported that movement patterns were roughly divided into discrete and rhythmic patterns in the early stages of learning of fundamental skill in juggling (Yamamoto et al., 2015). Meanwhile, in sports scenes, performers are required to perform stable performance under various constraints (Seifert et al., 2013). In this study, we examined whether these typical two patterns in juggling task have equivalent adaptability to perform under various temporal constraints.
Methods
Six expert juggles and 12 intermediate jugglers participated in this experiment. Participants were asked to perform juggling by adjusting the catch timing to the gradually changing tempo. The stimulus sound changed from 300ms to 600ms with 3ms interval each beep (Down condition) and vice versa (Up condition). The performance index of this task was evaluated by using asynchrony between beep and catch timings. In addition, the transition of movement pattern according to changing tempo was used as a behavioral index during performing adaptation task. Then, we compared these indices among participants' preferred patterns.
Results
As a result, for intermediate jugglers, the performance of the task indicated that participants with discrete pattern showed better adaptation than participants with rhythmic one ($r = 0.64$ for Up condition, $r = 0.59$ for Down condition). Therefore, the behavioral index indicated that good adaptation was performed by appropriate switching of patterns according to changing temporal constraints. However, for experts, those with discrete patterns as well as those with rhythmic patterns showed good adaptation.
Discussion

These results indicate that there is a difference in adaptability which requires appropriate switching of movement patterns between their own preferred patterns acquired in the learning process of fundamental skill. These results also suggest that such adaptability to constraints could be acquired during the process to be skilled juggler, regardless of learners' unique patterns.
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Contact
ykota13@gmail.com

THE EFFECT OF VISUOSPATIAL WORKING MEMORY TRAINING ON EFFICACY OF EXECUTIVE FUNCTION & PERFORMANCE

FATHIREZAIE, Z.1, ZAMANI-SANI, S.H.1, EBRAHIMI, S.1, BRAND, S.2
1:UNIVERSITY OF TABRIZ, 2: UNIVERSITY OF BASEL

Introduction
The purpose of this study was to investigate the effect of cognitive training by working memory tasks on executive function network efficiency & accuracy of response (performance) in semi-skill table tennis players.
Methods
The design of the study was semi-experimental with pretest and posttest. Therefore, 20 participants were divided into two training group: cognitive training (n=10) and control (n=10) group. Cognitive group received visuospatial working memory task training and control group have did usual training of table tennis without cognitive factor in two simple mobility skills (forehand and backhand). Participants performed attention networks test & accuracy response in pre and post of 8 sessions of training.
Results
Results showed significant differences between two groups in each factor (executive function network efficiency & accuracy of response). Cognitive training group showed improvement in executive function network efficiency while control group didn't showed. Response of accuracy was improved in both group but cognitive training group showed more improvement rather than control.
Discussion
Based on study results, it seems that cognitive training has positive effect on neural network efficiency and response accuracy and this issue indicates increased effect of intra network communication and the flexibility of the brain toward repeating and practicing. The results of studies by Olesen et al showed that changes relevant to the practice of working memory tasks is accompanied with the increase in Prefrontal and parietal lobes activities (Olesen et al., 2004). And, this issue shows the effect of increasing the intra-network communications and the flexibility of the brain toward repeating and practicing. Therefore, it might be said that cognitive training has more positive effects on performance and cognitive abilities due to the involvement of more cognitive capabilities such as memory, attention, perception and also more involvement of brain networks and facilitate of synaptic connection.
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Contact
Zahra.fathirezaie@gmail.com

EFFECT OF MOTOR IMAGERY SPEEDS ON SOCCER DRIBBLING AMONG SKILLED PLAYERS

ZAMANI SANI, S.H.1, FATHIREZAIE, Z.1, DEGHATINAJD, K.2, FARSI, A.3, BRAND, S.4
1: UNIVERSITY OF TABRIZ (TABRIZ, IRAN), 2: PAYAME NOOR UNIVERSITY (KARAJ, IRAN), 3: SHAHID BEHESHTI UNIVERSITY (TEHRAN, IRAN), 4: UNIVERSITY OF BASEL (BASEL, SWITZERLAND)

Introduction
According to Louis et al (2008), voluntary changes in motor imagery (MI) speed elicit similar unconscious changes in the speed of actual motor performance. In addition, this effect has been seen in highly automated tasks where timing is fixed or controlled. It appears that not controlling MI speed may thus alter the technical execution of a motor skill (Guillot & Collet, 2008). Therefore, the purpose of this study was to investigate the effect of MI speeds on soccer dribbling among skilled players.
Methods
To fulfill this purpose, 30 participants were assigned to three groups with either fast speed (FS), real speed (RS) imagery, and a control group (C) without imagery. Prior to group assignment, participants were assessed in terms of ability in soccer dribbling and imagery. The dribbling protocol of this study was similar to that of O and Munroe-Chandler (2008). After pretest, 3 sessions of imagery training of soccer dribbling (30 trails in each session) were performed. Retention testing was performed after the 3rd session of imagery training. All data (performance times) were collected with 8 cameras of 3D Motion Analysis.
Results
The results of covariance showed significant differences among groups in the dependent variable ($F(24, 2) = 22.61$, $P= 0.0001$, Partial $\eta2= 0.65$), so that in comparison with the two other groups, the fast speed imagery group has faster performance time (FS-RS = -2.37 s, $p = 0.0001$ and FS-C = -2.45 s, $p = 0.0001$). Based on study results the assimilation effect (Boschker et al 2000) is supported in dribbling of skilled soccer players.
Discussion
Our findings suggest that increasing MI speed among skilled soccer players, in accordance with their existing skill level, resulted in better dribbling performance.
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Contact

hojjatzamani8@gmail.com

THE EFFECTS OF BLOCKED AND RANDOM IMAGERY ON LEARNING OF SOCCER SKILLS: WITH A FOCUS ON MEDIATING ROLE OF MENTAL IMAGERY ABILITY

TAHMASBI, F.1, HATAMI, F.1, ROUKI, H.1

1:SRTTU(TEHRAN, IRAN)

Introduction
Contextual interference refers to the degree of interference created by the ordering of skills within a practice session. It is well known that mental skills such as mental imagery are highly related to successful accomplishment of tasks. Mental imagery is an intervention, which may bring about favorable outcomes including better self-confidence and improved performance. Although, imagery ability may affect the effectiveness of imagery intervention, the purpose of this study was to examine the effect of blocked and random imagery on learning of soccer skills with a focus on mediating role of imagery ability.
Methods
Sixty students of a soccer school (mean age: 14.52±1.02 years) voluntarily participated in this study and completed movement imagery questionnaire-revised (MIQ-R). Participants were divided into kinesthetic and visual imagery ability groups, based on imagery ability scores, then each of these two groups were randomly assigned into three groups of blocked Imagery, random Imagery, and control groups. Recorded audio tape for mental imagery exercises of soccer skills were used during the acquisition phase. Soccer skills includes side foot pass, shot and head hit. Blocked imagery group were asked to imagine three soccer skills with block arrangement (2 trials for each skills) and random imagery group imagined skills in random arrangement.
Results
Results of two-way ANOVA in post test showed that imagery arrangement (blocked-random) main effect was significant and imagery ability (visual- kinesthetic) and interaction effect of both variables were not significant In the other words, Blocked imagery group significantly achieved better scores than random imagery and control groups. In addition, random imagery group had better performance compared to control group. In retention and transfer test, random imagery group showed better performance than blocked and control groups, and blocked group compared to control group, significantly.
Discussion
Based on the findings of the present study, contextual interference effect in imagery of soccer skills was found and findings suggest that using contextual interference (CI) effect in mental imagery training is beneficial for learning of selected soccer skills, regardless of imagery ability.
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Contact
farshidtahmasbi@yahoo.com

Mini-Orals

MO-PM06 Testing, training and recovery

VALIDATION OF THE METHOD FOR EVALUATION OF ANAEROBIC THRESHOLD IN A WORKING MUSCLE

ORLOVA, E.A., POPOV, D.V., BOROVIK, A.S., LYSENKO, E.A., BUTKOV, A.D., VINOGRADOVA, O.L.

SSC RF INSTITUTE OF BIOMEDICAL PROBLEMS RAS

Introduction
Anaerobic threshold (AT) is a very important and robust predictor of aerobic performance in sport, fitness and rehabilitation. Many methods detecting AT during incremental test were described in the literature. Systemic physiological indices (blood lactate concentration, pulmonary ventilation, carbon dioxide production and oxygen consumption rates etc.) are used for calculation of AT in most of these methods. It means these methods can be correctly applied for work of large muscle mass/whole body exercise (running, cycling, skiing etc.) only. Previously we described a method for detection of AT using EMG and near-infrared spectroscopy data in a working muscle (Kuznetsov S. et.al., 2015). It is possible to use the method for evaluation of AT during incremental work of either small or large muscle mass. The goal of the work was to validate the method.
Methods
We evaluated 1) the test-retest reliability of the method and 2) the responsiveness of the method in detecting an increase of aerobic performance after/the effect of 8 wk cycling training. 12 physically active males and 10 untrained males participated in the first and second parts of the study, accordingly. 1) The physically active males performed two cycling incremental tests till exhaustion separated by a week; iEMG and deoxyhemoglobin content in vastus lateralis muscle as well as capillary blood lactate level were evaluated during the tests. AT was evaluated using either our method or well-described lactate threshold (LT) method. 2) An increase of aerobic performance of knee extensor muscles was evaluated after 8 wk cycling training (1 h x 5/week) using incremental one-legged knee extension test till exhaustion. During the tests iEMG and deoxyhemoglobin content in vastus lateralis muscle were measured.
Results
1) AT evaluated by our method significantly ($P<0.01$) correlated with LT method. Coefficients of variation (CV) were ~4% and ~2% for our method and LT method, accordingly. 2) AT evaluated during one-legged test significantly increased (17%, $P<0.05$) after 8 wk cycling training.
Discussion

AT of the working muscle evaluated using iEMG and deoxyhemoglobin content demonstrates good reliability: CV was low and comparable with CV for LT method. Our method is appropriate for detection an increase of aerobic performance for a small working muscle.
The work is performed according to the Plan for Fundamental Research of SRC RF Institute of Biomedical Problems RAS and with partial financial support of the Fundamental Research Program of Presidium of RAS.

RELATIONSHIP BETWEEN STRENGTH, JUMP AND VELOCITY PROFILE TO SPRINT PERFORMANCE OF SPRINTERS DURING A FOLLOW UP OF AN INDOOR SEASON.

NUELL, S.1, ILLERA, V.1, ALOMAR, X.2, CARMONA, G.1, PADULLÉS, J.M.1, PADULLÉS, X.1, CONESA, S.1, LLORET, M.1, CUSSÓ, R.2, CADEFAU, J.A.1,3

1:INEFC-UB; 2:CREU BLANCA 3: BIOMEDICINE DEP. UB (BARCELONA, SPAIN)

Introduction
Performance in sprint events seems directly related to the level of force and the rate which its force is generated. Sprinters have little time to apply force to the ground; in this sense, the force should be applied as fast as possible; hence, the force–velocity relationship (power) is a determining factor for success in sprint running (Alcaraz et al. 2011). The aim of this study was to find relationships between strength, jumps and power-force-velocity profile to sprint performance of a group of sprinters.
Methods
12 national level sprinters Senior and Under-23 (23.5± 4.2 y.o.) were screened during an Indoor Season (from September to final of February). They were tested just before they started their training regime (Pre-Training Test) and before the main competition, the National Championships, (Post-Training Test). Testing procedures included Maximal Voluntary Isometric Contraction (MVIC) of knee extensors (TorqExt) and flexors (TorqFlex), a protocol of jump test including Squat Jump (SJ), Counter Movement Jump (CMJ) and Drop Jump using arms (DJa), a 40 meters dash using a radar gun (Vmax) and the time to run 80 (80m) and 150 (150m) meters sprint using photocells.
Results
After the four months of follow up TorqExt increased 8.59% (p=0.044), SJ increased 18.7% (p=0.00), CMJ increased 10.6% (p=0.001), DJa increased 10.2% (p=0.002), Vmax 3.24% (p=0.000), the time to run 80 meters decreased 4.4% (p=0.000) and the time to run 150 meters also decreased 4.4% (p=0.000) while the 4.2% improvement in TorqFlex was not significant.
Moreover, the results show significant correlations between all six variables (TorqExt, TorqFlex, SJ, CMJ, DJa and Vmax) and the performance in these two typical sprint distances (80 and 150 meters). As expected the sprinting maximum speed showed the highest correlation (R=-0.975 p=0.000, with 80m) and (R=-0.978 p=0.000, with 150m)
Discussion
The neuromuscular performance assessed using MVIC, various vertical jumps and maximum speed in a 40 meters dash was highly correlated with the performance in sprint events, suggesting that maximal strength and power development are crucial to reach high speeds, as reported previously (Loturco et al. 2015).
From a practical point of view this study encourages coaches to asses sprint performance by using strength and jump test.
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Contact
serginuell9@gmail.com
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THE EFFECT OF EXTENDED FAMILIARISATION ON ISOKINETIC AND ISOMETRIC MEASUREMENTS

BISSAS, A.

LEEDS BECKETT UNIVERSITY

Introduction
Considering a) that the 'learning effect' in isokinetic assessments may impact on a clinician's ability to detect genuine changes in muscle function and b) the rare nature of constant velocity movements in daily activities, it becomes apparent that familiarisation is key to optimising the reproducibility of measurements. This study examined the impact of testing protocols which differed in repetition number and rest intervals on the reproducibility of isokinetic and isometric measurements conducted on the knee extensors and flexors across multiple testing sessions.
Methods
12 males (age: 23.3 ± 1.6 years; height: 1.80 ± 0.06 m; mass: 83.2 ± 9.6 kg) were randomly divided into a LONG and SHORT group and completed 6 group-specific testing sessions (48-96 hours rest between visits) which involved maximal isokinetic (30, 90 and 180 deg/s) and isometric repetitions (extensors: 70 deg – flexors: 50 deg) in seated and prone positions on a Cybex NORM dynamometer. The LONG protocol involved 70 submaximal and 36 maximal repetitions and a total resting time of 3140s whereas the SHORT included 40 submaximal and 24 maximal repetitions with a total resting time of 2360s. A range of statistical techniques including measures of reliability were employed.
Results
Overall the LONG group exhibited higher torque values (10-25%) for extensors and flexors under both isokinetic and isometric conditions. However, a mixed-design ANOVA revealed no main effects for each factor (group, visit) nor any significant interaction. Intraclass Correlation Coefficients (ICCs) for the isokinetics did not show any trend between visits but generally the LONG protocol produced consistently ICCs over 0.90 (mean ICC: LONG = 0.92 vs SHORT = 0.83). LONG group values for Standard error of measurement, Typical error, Limits of agreement and Coefficients of variation were slightly better than SHORT. The LONG protocol produced better reliability for the isometric extensors torque (ICC: 0.93 vs 0.67) but the SHORT for the flexors (ICC: 0.78 vs 0.95).
Discussion
A single visit can produce similar results as repeat visits providing a conventional protocol is applied and strict adherence to testing principles (stabilisation, instructions, feedback) is ensured. Two sessions may be adequate to "learn" the movements and reach a satisfactory degree of performance stability. However, a longer protocol comprising an increased number of submaximal-maximal trials (≥ 20

per speed) supplemented by rest intervals of 30-90s (between repetitions-speeds) and 10min between positions, and a prone position for leg flexors can offer additional reliability. Ultimately, the exact level of acceptable reproducibility is always decided by the researcher after considering sample characteristics and type of application.

Contact
a.bissas@leedsbeckett.ac.uk

THE EFFECT OF DIFFERENT DURATIONS OF HALF-TIME RE-WARM UP ON THE SUBSEQUENT SPRINT PERFORMANCE

YANAOKA, T., MASUDA, Y., YAMAGAMI, J., KASHIWABARA, K., KURATA, K., KIDOKORO, T., MIYASHITA, M., HIROSE, N.
WASEDA UNIVERSITY

Introduction
In the football game, the amount of high-intensity running, known to be an important performance indicator, decreases in the initial part of the second half (Mohr et al. 2005). Moderate-intensity exercise for 7 min during half-time (half-time re-warm up (RW)) maintains subsequent exercise performance (Russell et al. 2015). However, consideration must be given to the duration of RW since players have little time to perform a RW during half-time (Russell et al. 2015). Therefore, the purpose of the present study was to investigate the effect of different durations of RW on the subsequent sprint performance.
Methods
Ten healthy men (age: 22.3 ± 2.3 years, height: 172.2 ± 6.0 cm, body mass: 67.4 ± 10.1 kg, VO2max: 47.4 ± 4.3 mL/kg/min) were participated. Using a randomised crossover design, participants performed two, 40 min of intermittent exercises interceded by a 15 min half-time. During the half-time, participants either rested for 15 min (Control), rested for 7 min followed by cycling at 70% of HRmax for 7 min (7 min RW) or rested for 11 min followed by cycling at 70% of HRmax for 3 min (3 min RW). The second 40 min intermittent exercise was the Cycling Intermittent-Sprint Protocol (CISP), including twenty, 5 s sprints (Hayes et al. 2013). Work done (WD) during twenty, 5 s sprint in the CISP was determined. Oxygen uptake (VO2), tympanic membrane temperature (Tty) and skin temperature (Ts) were measured throughout the study.
Results
The mean WD in the initial 10 min of the CISP tend to be higher in the 7 min and 3 min RW trials than the control trial (control: 3763±896 J, 7 min RW: 3955±955 J, 3 min RW: 3952±999 J, two-factor ANOVA: trial; P=0.03, vs 7 min RW: P=0.10, vs 3 min RW: P=0.06). The mean VO2 in the initial 10 min of the CISP tend to be higher in the 7 min and 3 min RW trials than the control trial (control: 29.4±2.4 mL/kg/min, 7 min RW: 30.7±2.7 mL/kg/min, 3 min RW: 31.0±2.3 mL/kg/min, two-factor ANOVA: trial; P<0.01, vs 7 min RW: P=0.07, vs 3 min RW: P=0.02). The decrement of the Tty and Ts during the half-time were lower in the 7 min trial than the control and 3 min RW trials (P<0.05).
Discussion
The present findings demonstrate that both 7 min and 3 min RW improves WD and increases VO2 for at least 10 min after half-time. Given the nature of half-time, these findings indicate that a short duration of RW may be an effective conditioning strategy for subsequent exercise performance.
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A NOVEL D2O TECHNIQUE FOR DYNAMIC QUANTIFICATION OF SKELETAL MUSCLE RNA SYNTHESIS IN RELATION TO EXERCISE AND RIBOSOMAL BIOGENESIS

BROOK, M.S., WILKINSON, D.J., MITCHELL, W.K., LUND, J.L., PHILLIPS, B.E., SZEWCZYK, N.J., KAINULAINEN, H., LENSU, S., KOCH, L.G., BRITTON, S.L., GREENHAFF, P.L., SMITH, K., ATHERTON, P.J.
NOTTINGHAM UNIVERSITY

Introduction
Cellular protein synthesis is determined by both activity (translational efficiency) and amount (translational capacity i.e. RNA content) of ribosomes. Stable isotopes have routinely shown that bouts of resistance exercise (RE) induce acute increases in translational efficiency i.e. muscle protein synthesis (MPS) [1], cumulatively promoting muscle hypertrophy. Yet, changes in translational capacity (ribosomal biogenesis) are also a key feauture of RET [2]. Nonetheless, no practicable methods exist to quantify dynamic RNA synthesis. We aimed to develop D2O methods to quantify muscle RNA synthesis in vitro, in vivo exercise models, and in humans.
Methods
Proliferating C2C12 cells were incubated in 2H-enriched media (and myotubes: ±50ng/ml IGF-1). In rodent studies, quadriceps from untrained (N=9) and exercised (N=13, treadmill 3x3min 80-95% VO2-peak 3/wk) rats were collected after 3-wks. Drinking water was enriched with D2O and blood samples taken to quantify body water enrichment (BWE). In human trials, 10 (23±1y) men undertook 6-wks unilateral RE (6×8 reps, 75%-1RM 3/wk). Subjects consumed 150ml D2O (70-Atom%) and then 50ml/wk. BWE was monitored by saliva and RNA synthesis in muscle biopsies 0/3/6wk. RNA was subjected to enzymatic digestion, derivatised to benzyl hydroxylamine tetraacetate derivatives, with mole percent excess (MPE) of ribose from purine nucleotides analyzed on GC-MS/MS via monitoring M/M+1 isotopomers.
Results
Proliferating C2C12 cells exhibited an amplification of 2.1 2H into ribose, with MPE following a rise to plateau i.e. 2H incorporation is reflective of "new RNA" and thereby de novo ribosomal biogenesis. IGF-1 increased RNA abundance in myotubes from 76±3ng/ul to 123±3ng/ul, mirrored by increases in MPE to 0.39±0.1% (both P<0.01). Rat quadriceps MPE increased to 0.25±0.01% (P<0.01) and was greater with exercise to 0.36±0.02% (P<0.01). RNA synthesis positively correlated with MPS (P=0.05, r2=0.2). Human muscle RNA MPE increased to 0.06±0.01% and 0.13±0.02% at 3 and 6-wks RE respectively, representing ~1%/d turnover. With RE, RNA synthesis was greater at 3 and 6-wks: 1.9±0.3%/d (P<0.01) and 1.6±0.1%/d (P<0.05) respectively. Again, RNA synthesis correlated with MPS (P<0.001, r2 =0.7).
Discussion
We have developed and validated a novel method for the measurement of in vitro and in vivo RNA synthesis, which holds promise for investigating the role dynamic changes in translational capacity has in the mechanistic control of muscle hypertrophy and atrophy.
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Contact
mzxmb2@nottingham.ac.uk

Mini-Orals

MO-PM14 Coaching: Practical questions

CORELATION BETWEEN STATIC AND DYNAMIC BALANCE AMONG ADULTS. GENDER DIFFERENCES

SHALAJ, I.1, CAKA, A.1, GASHI, F.1
UNIVERSITY OF PRISTINA

Introduction
Everyone has an individual coordination value. The scientifically recognized S3 check determines a person's S3 value by applying the "three S analysis" – symmetry, stability and senso-motorics. Stability is a basic requirement for good coordination, and for active control of posture and movement. The aim of the study was to examine the relationship and gender difference between static and dynamic postural stability in a healthy group of subjects.
Methods
The current clinical trial study was carried out in the University of Pristina, department of Physiotherapy, Prishtina during year 2016.
A group of 53 normal subjects (23 males and 30 females), 18-50 years of age, were participate in the study. The symmetry, stability and senso-motorics of the subjects was measured with MFT-S3 Fit Disc device. We have compare the regression coefficients of males with females to test the null hypothesis Ho: Bf = Bm, where Bf is the regression coefficient for females, and Bm is the regression coefficient for males.
Results
The mean Static Balance test by Male is 52.46±8.06 (min=33, max=62). Dynamic Balance test has mean 27.93±6.61 (min=21, max=39).
The mean Static Balance test by Female is 54.13±10.23 (min=33, max=92). Dynamic Balance test has mean 32.03±8.21 (min=20, max=44).
Comparison of regression coefficients by gender, indicating that the regression coefficient Bf is not significantly different from Bm (T=0.507, p=0.614).
Discussion
Althought the regression coefficients for females and males suggest that Static Balance is a stronger predictor of Dynamic Balances for female (1.326) than for male (1.21), correlation between static and dynamic balance does not differ by gender.
Contact
Ishalaj1@hotmail.com

FEASIBILITY STUDY ON DIFFERENT KIND OF FLEXIBILITY TRAINING: VIBRATION VS. CLASSIC STRETCHING

GAHLEN, M., MARIACK, L., SILL, M., ZWANZIGER, M., KRAKOWSKI-ROOSEN, H.
UNIVERSITY OF APPLIED SCIENCES HAMM-LIPPSTADT

Introduction
The purpose of this feasibility study was to investigate the acute effects of different stretching methods. In former studies the effectiveness of static stretching has been proven. [Behm et al. 2016] Some recent studies deal with the effects of vibration stretching training, e.g. stretching on a vibration-platform. [Kurt et al. 2015].
Methods
25 volunteers (10m, 15f) were randomly advised to two groups: a control group (CG) participated in a self-organized classic stretching program with six exercises once a day. One intervention group (IG) participated four times a week a stretching program on the new flexx-vib machines (hip, chest and legflexor; proxowell GmbH, Luhden, Germany). The machines work with a vibration of 5Hz. IG made two repetitions with 30 seconds each. The completely training period was four weeks, because of cross-over design the two groups changed after two weeks. Three tests has been performed with Janda concept [Schildt-Rudolff et al. 2014], first at the beginning, second after two weeks, last at the very end.
Results
There was a drop out of 10 participants. The results indicated a high improvement (62.9%) in the females for both training interventions. Enhancement in the males had been lower with 55% for vibration and 50% on classic training.
Discussion
The high dropout rate might be because of low motivation and "boring" stretching exercises. Furthermore, many participants reported pain especially of the back and the neck. To avoid the high dropout rate training should include personal supervision especially for the training on the vibration machines. For enhancing accuracy and reliability, further data is needed. The consecutively study will include more participants and a stronger supervised training regimen.
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Contact
Mirjam.Gahlen@hshl.de

THE INFLUENCE OF FOAM ROLLING ON FLEXIBILITY AND MUSCLE ARCHITECTURE

YOSHIMURA, A.1 , INAMI, T.1, MINETA, S.1, SHUDO, K.1, MARIANO, R.1, HIROSE, N.1

1: WASEDA UNIVERSITY

Introduction

Soft tissue mobilization with the foam roller (FR: Foam Rolling) is known as one method of conditioning technique. Previous studies indicated that FR increases joint range of motion (ROM). However, FR effects vary by time and intensity of intervention, and therefore, perspectives on it has not yet been unified. Also, no previous study of differential effects by individual characteristics has been conducted. On the other hand, there are a lot of flexibility determinants in ankle ROM about bone structure, arrangement of muscle and so on [Alter et al. 2010]. Muscle fiber extensibility influences flexibility especially in the case of passive ROM [Kawakami et al. 2003]. The purpose of this study was to investigate the influence of FR on ROM and fascicle length (FL).

Methods

The subjects were 22 healthy men (19-24 yrs), and they performed FR (Grid® Foam Roller, Mueller, Japan) targeting medial gastrocnemius (MG) for 3 sets of 1-minute in duration with a 30-second rest between sets. The subjects passive ankle ROM and B-mode ultrasound images (Aixplorer, France) in 30°plantar flexion (PF) between pre and post were measured. The distance between superficial aponeurosis and deep aponeurosis was measured, and this was used to calculate FL. The amount of FL change between pre and post was calculated, and the subjects were divided into two groups, "extended FL group" (FL-ext) and "shortened FL group" (FL-short). A two-way ANOVA with repeated measures were used to analyze the influence of FR, and $p<0.05$ was considered statistically significant.

Results

ROM of PF and dorsiflexion (DF) increased significantly between pre and post FR (PF pre:41.8±3.9°, post:45.4±4.3°; DF pre:27.7±5.3°, post:33.5±6.1°). The subjects were divided into two groups FL-ext (n=10) and FL-short (n=12), and FL changed significantly between pre and post FR in both groups (FL-ext pre:4.9±0.4cm, post:5.4±0.3cm; FL-short pre:5.2±1.1cm, post:4.5±0.9cm). Also, FL showed a significant difference between two groups post FR. But the increasing rates of ROM differed between these two groups (FL-ext PF:10%, DF:20%; FL-short PF:7%; DF:21%), ROM improved significantly in both groups.

Discussion

The result of this study supported previous studies that FR increases ROM, that is, that it improves flexibility. In addition, it was considered that FR changed muscle architecture in position where passive torque of muscle was zero (PF30°). However, mechanisms of flexibility improvement didn't become clear because ROM increased no matter whether FL changes by FR. It is necessary to consider soft tissue elasticity and viscosity, skeletal muscle mass, and increase connective tissue as further research.

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Contact

0906akane@gmail.com

COMBINING PHYSICAL EXERCISE WITH COMPLEX TASKS CONTRIBUTES TO NEURO-COGNITIVE ACTIVATION

KIMURA, K.1, FUKUSHIMA, F. 1, YOSHIDA, M. 2, TANAKA, K. 1

1: TDU (TOKYO, JAPAN), 2: OCHANOMIZU UNIV (TOKYO, JAPAN)

Introduction

Recently, physical exercise has been focused on as being beneficial for maintaining and improving cognitive function. These reports suggested that the unique aspects of task complexity with regard to sports experience (dance, tai-chi, ball sports, etc.) effectively facilitate neuronal networks responsible for cognitive behavior. The present study was conducted to demonstrate the correlation between exercise complexity and neuro-cognitive activation within the executive cognitive network by having participants observe and mentally rehearse a full-body dance performance.

Methods

Functional magnetic resonance imaging (fMRI) was employed to identify the cognitive neural activation while participants were observing a pre-recorded movie of a dance performance. Thirty-eight participants (average age: 21 years) took part in this study. The participants were asked to observe and mentally rehearse the instructor's full-body dance choreographs while watching the video. Participants were randomly assigned into two groups: one group observed a simple dance (SD) choreograph in which 4 types of step routines were switched every 16 seconds, and in the next session they observed a coordinative dance (SD+C) in which upper body actions were coordinated with the SD choreograph. The second group observed a complex dance (CD) choreograph in which the same steps as SD were switched every 4 seconds, and next they also observed an upper-body coordinative dance (CD+C) synchronized with the CD choreograph. All participants underwent fMRI scanning as they watched the dance movie. Neural activations were compared between the SD and CD groups.

Results

In the results, the following areas were activated: the premotor and supplementary motor cortices, the cingulate gyrus, and the inferior parietal cortices. However, the CD group showed that the activations in those areas tended to increase more than the SD group. In addition, it was recognized that the factor of coordinative condition produced different effect between the SD and CD groups. For instance, neural activations for the CD+C condition attenuated compared with those of the CD condition, likewise, the SD+C and SD conditions showed a similar activation patterns in those regions.

Discussion

The results showed that observing dance performance activated the executive-cognitive network associated with complex dance movements. Notably, the number of motor tasks in a dance choreograph may lead to more intense activation of the cognitive network. However, it is inferred that unfamiliar or overly difficult motor tasks for individuals such as the coordinative conditions, may reduce overall performance of the neuro-cognitive network.

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Contact

kimura@cck.dendai.ac.jp

RESEARCH ON THE DIFFERENCE BETWEEN THE PLAYER RETIRED AT THE YOUTH AGE IN TOP LEVELS, AND THE PLAYER WHO CONTINUED EVEN THE SENIOR

UEMATSU, Y., ITO, M., SUZUKAWA, K., SAKAMOTO, S., GUSHIKEN, T.

NIPPON SPORT SCIENCE UNIVERSITY

Introduction
Becoming a high-performance athlete is not an easy task, tons of deliberate practice have to be done to achieve elite performance. It would take more than ten years (Ericsson et al., 1993). Athlete thinks deeply relationship with coach and parents during this period. Accordingly, a coach must have superior interpersonal knowledge as well as professional knowledge to show high performance in gymnastics. In the present study, the reason why top level junior gymnast quit the sport before becoming a senior athlete while some can continue playing the sport to become to exhibit elite performance as seniors.
Methods
Semi-structured interviews were conducted on two women of trampoline gymnasts. They were selected as the informants of this study because both athletes exhibited top levels performance internationally as junior, however one athlete quit her sport before competing as senior and another athlete continued and played an active part in the world. All the interviews were recorded with IC recorder and transcribed verbatim. For the qualitative analysis, Steps for Cording and Theorization was utilized (Otani, 2008). Briefly SCAT follows the steps: 1) specifying important words and phrases, 2) rewording those words and phrases into more general expressions, 3) conceptualization, 4) producing themes, and 5) writing a story line.
Results
Both athletes had the capability to change various pressures into positive thinking. However, the factor which exceeds it was the relationship of a coach and a player. And one of the major factors of the retired player was the relationship of an athlete and the coach who were thought about by Japanese culture (Tomozoe, 1983).
Discussion
Coaching has dynamic and complex nature. How we define the success in coaching would be difficult, however, the situation in which athletes quit the sport because of the coaching is flaw. So, coaches need to reflect on our coaching and should keep trying to improve their crafts and be athlete-centered. A coach does not think one-sidedly, and it is necessary to think in the athlete centered constituent.
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PRACTICAL OVERTRAINING SYNDROME ON IMMUNITY IN ATHLETES

HAN KYO, S.

SHIN HAN UNIVERSITY

The present goal of this study is to analyze the overtraining syndrome's definition, sign, symptom, etiology, prevention, and treatment with physical training and also we analyzed the practical approaches between overtraining syndrome and immune responses in overtraining syndrome athletes. Overtraining syndrome is described as a form of chronic fatigue, burnout and staleness, and it is also defined as an imbalance between physical training versus recovery. It appears to be caused by the total amount of physical, psychological and immunological stress on the club sports people and athletes. It is well characterized by declining physical performance when maintaining a normal training program. This is caused by the failure of movement adaptation within physical and sometimes neuroendocrine system. Actually, It can be a part of healthy training, if only done for a short period time. However chronic overtraining can be a serious problem including adrenal insufficiency. Athletes undergoing a strenuous training schedule can develop a significant decrease in physical performance associated with overreaching and overtraining syndrome. It is also related with adaptation to performance, impairment of psychological conditions, and even immunological dysfunction. Generally, one of the well found outcomes of overtraining syndrome is an immunological infirmity which become apparent through an augmented frequency of colds. Thus, overtraining syndrome is more than a simple physical syndrome, it includes mental and emotional factors as well. It might have strongly damaging effects on an athlete's career and the prevention is of most importance. However, the medical diagnosis of overtraining syndrome is difficult to quantify and moreover physiological, psychological, neuroendocrine, and immune systems are more complex and it is not adequately elucidated. Through this paper, we want to analyze the exact etiology and symptoms of overtraining syndrome with immune connections and moreover we want to provide the many experimental protocol to athletes, coaches, and researchers in this fields. Therefore, we want to present (1) definition, etiology, symptoms and mechanism of OTS, (2) immunological aspects of OTS, (3) prevention and treatment of OTS. And also we discuss about the experimental approaches to overtraining syndrome in the final section.

Mini-Orals

MO-PM15 Swimming and cycling

EFFECT OF DIFFERENT POSITION OF THE FRONT AND REAR FEET ON THE KICK-START PERFORMNACE IN MALE

SUITO, H., OZEKI, K., KATAOKA, Y., IKEGAMI, Y.

AICH GAKUIN UNIVERSITY, OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES, AICHI UNIVERSITY OF EDUCATION, AICHI SHUKUTOKU UNIVERSITY

Introduction
In a recent study, it was concluded that a kick-start by the use of a back plate was significantly faster off the block, with a higher horizontal velocity at take-off and an increased on block horizontal force (Honda, K.E., et al., 2010). The kick-start is a variation on this with one foot at the front edge of the block and the other is displaced towards the rear of the block. Swimmers are likely to perform better using their preferred positions of the front and rear feet in kick-start. However, Tor, E., et al., (2015) reported that elite swimmer's preferred

movement pattern may not be their optimal technique. Therefore, this study was to investigate the effect of different positions of the front and rear feet on the kick-start performance in male competitive swimmers.
Methods
Subjects were 14 male Japanese competitive swimmers. We asked all subjects to start at two positions (preferred feet position and non-preferred feet position) using a kick-start technique. The start motions of all subjects were captured two-dimensionally from the start signal until the entry into the water by using the high-speed camera (120 Hz). The velocity vector of center of mass and the angle of attack with respect to horizontal axis were computed at take-off. In addition, the timing to 5 m and 15 m were assessed by the displacement of swimmers' head using high-speed cameras operating at 120 Hz.
Results
The horizontal velocity at the take-off of the preferred feet position was significantly higher than the data of the non-preferred feet position ($P < 0.05$). Moreover, 5-m time and 15-m time of the preferred feet position was significantly shorter than the results of the non-preferred feet position ($P < 0.01$). Initial movement time and reaction time were not significantly different.
Discussion
The results of this study suggested that the initial movement time and reaction time of the preferred feet position and the non-preferred feet position were of equal values. However, the horizontal velocity at the take-off of the preferred feet position was higher than the non-preferred feet position. Therefore, the preferred feet position may increase on block horizontal force in kick-start.
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Contact
suito@dpc.agu.ac.jp

HOW DOES STROKE RATE INFLUENCE ARM COORDINATION AND SWIM EFFICIENCY AT MAXIMAL SPEED

SIMBANA-ESCOBAR, D., LUDOVIC, S., HELLARD, P.

FRENCH SWIMMING FEDERATION

Introduction
Sprint performance in front crawl swimming has greatly improved these last two decades. This improvement may be explained partially by the modification of swimming skills such as the stroking parameters (stroke length and stroke rate), arm coordination and indicators of swim efficiency such as velocity variations. (Sidney et al., 2011) have suggested that in long term, swimmers should focus on increasing their stroke length rather than their stroke rate in order to increase their swimming speed. In swimming, swimmers must find the optimal combination of stroke length and stroke rate to maintain the highest possible speed according to a set of constraints (task, environment, individual;(Newell, 1986)). The goal of this study was to understand the impact of controlling stroke rate on stroke length, swimming speed arm coordination and velocity fluctuations during sprint performance. Through our pilot study (i.e. case study), we hypothesize that using efficiently a large range of stroke rate and with a flexible arm coordination could reach high swimming speed.
Methods
One national swimmer (51.96 s in 100m freestyle, 1.87m, 75kg, 17 years) performed 9 X 25m trials in two different sessions. In each trial, the stroke rate pacing was controlled by an Aquapacer metronome that was placed into the cap of the swimmer. This stroke rate was set between 41 to 66 stroke/min in a random order and 4 minutes of recovery was allowed between swims trials to avoid fatigue. The swimmer was equipped with three wearable inertial measurement units (IMUs), two at the middle of the forearms and one at the sacrum, validated algorithms was used to detect automatically the front crawl arm stroke phase (entry, push, pull, and the recovery) of each arm and then to compute the index of coordination (IdC) (Dadashi et al., 2013). We assessed the variability with two indicators: cycle velocity variation (CVV) and intra cyclic velocity variation (IVV) (Dadashi et al., 2015).
Results and Discussion
The superposition coordination (IdC>0%) increases with stroke rate at maximal speed. IdC and push phases increase in a linear tendency with stroke rate (r2=0.86 and 0.71 respectively). The IVV and CVV did not exhibit any changes when the stroke rate was increase, suggesting a high efficiency. However, at maximal stroke rate, the variability seems to be more important. Behavioral adaptability to task constraint (i.e. changes of stroke rate) seems to be an important feature of skilled swimmers and confirm previous studies about the interest of stroke rate manipulation during training (Potdevin et al. 2006),(Seifert et al. 2007).
Conclusion
This pilot study aimed to investigate the functional role of behavioral variability (by studying arm coordination, stroking parameters and indicators of swim efficiency) at maximal speed. Our findings need to be confirmed with more participants, in order to highlight whether a preferential range of stroke rate exists for each swimmer and should be trained to reach highest swimming speed.
Contact
david.simbana@ffnatation.fr

SHOULDER EXTERNAL/ INTERNAL ROTATOR MUSCLES TORQUES RATIO CHANGES IN RANGE OF MOTIONS IN MALE AMATEUR SWIMMERS

PONTAGA, I.

LATVIAN ACADEMY OF SPORTS EDUCATION

Introduction
Due to great number of stroke repetitions and propulsive force generated through upper extremity, shoulder is vulnerable to injury in swimmer (Heinlein, Cosgarea, 2010). The aim of study was to determine changes of shoulder external (ER)/ internal rotator (IR) muscles torques ratio in different positions of range of motions (ROM) in male amateur swimmers.
Methods
Twelve male amateur swimmers trained 90 minutes three times per week at least eight years participated. Mean age was 19.7 (SD 3.8) years, height 180 (6) cm, body mass 71 (9) kg. Tests were performed by a dynamometer system using shoulder isokinetic IR–ER movements. Elbow was flexed to 90º, humerus abducted in 90º to trunk. ROM was from 20º of ER to 100º of IR. Muscles were tested at angular velocities of 60°/s, 90°/s (five repetitions) and 240°/s (20 repetitions) by the concentric contractions (CC) and at 90°/s in the eccentric (EC) ER/ CC IR. Muscles peak torques, torques in different angular positions of ROM were obtained and ER/IR torques ratios were calculated from best repetition (with greatest maximal torque).

Results
Shoulder ER/IR muscles peak torques ratio in CC was 0.71 (0.12) in dominant (D) and 0.67 (0.09) in no dominant (N) arm at velocity of 60°/s, 0.69 (0.12) and 0.69 (0.08) at 90°/s, 0.59 (0.14) and 0.58 (0.08) at 240°/s, in EC ER/CC IR contractions at 90°/s this ratio was 0.71 (0.12) in D and 0.70 (0.09) in N arm. The differences between ratios in D and N arm are not significant ($p<0.05$). ER/IR muscles torques ratios in ROM at velocities of 60°/s, 90°/s increase in every angular position of the shoulder IR movement and at joint angle of 70° exceeded 0.70 in CC and 0.80 in EC ER/ CC IR contractions. ER/IR muscles torques ratios did not exceeded 0.62 in CC and 0.68 in the EC ER/ CC IR contractions in the beginning of the shoulder IR motion at ROM angles 30°, 40°, 50°. ER/IR muscles torques ratio 0.66 (0.12) in D and 0.62 (0.10) in N arm at velocity of 240°/s was lower in comparison with slower velocities and did not changed in ROM angles 50°–70°.
Discussion
Shoulder ER/IR muscles peak torques ratio is greater in comparison with torques ratios in ROM angles of 30°, 40°, 50°, but lower than ratios in ROM angles 70°, 80°, 90°, especially in EC action of ER. This confirms that shoulder rotator muscles action is worse balanced in the beginning of shoulder rotation movement. This coincides with hand entry into the water and early pull-through phase of free style swimming stroke, when hydrodynamic force applied on hand generates a large moment in shoulder joint, causing elevation of humeral head and impingement (Yanai et al., 2000).
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Contact
Inese.Pontaga@lspa.lv

DOES POLARIZED TRAINING IMPROVE PERFORMANCE IN COMPETITIVE SWIMMERS ?

PLA, R.

FRENCH SWIMMING FEDERATION

Introduction
To quantify the impact of training-intensity distribution on performance in competitive swimmers.
Methods
Thirty-two national swimmers were randomly assigned to two training groups : polarized training (POL) or threshold training (THR) during six training weeks. After a rest period, both training groups were reversed and trained during an other six weeks period. Before and after each intervention period, subjects performed a 100m test at maximal intensity. During each race, energetic contributions were collected using gas analysis and lactate analysis. Training was quantified based on the cumulative time spent in 3 intensity zones : Z1 (low intensity, <2mmol), Z2 (moderate intensity, between 2 and 4mmol), Z3 (high intensity, >4mmol). The contribution of total training time in each zone was monitored by a scientist. POL group trained more at low and high intensity (80/8/12), whereas THR group trained more at moderate intensity (68/24/8).
Results
Polarized group improved his 100m performance (481 +- 91pts vs 494 +-85pts). Threshold group was constant (488 +-84pts vs 487 +-70pts). Improvements were 3.3% (POL) vs 0.5% (THR), at post-training intervention. Those differences were not significant. Moreover, a subset analysis comparing the swimmers who improved their performance (PROG) with those who decreased their performance (REG) was realized. This analisis shaw greater improvements in anaerobic power for the PROG group.
Discussion
During a six weeks period, polarized training and threshold training have similar effects on swimming performance.

EVALUATION OF TRUNK MUSCLE FORCE IN BICYCLE PEDALING UNDER VARIOUS CONDITIONS USING INVERSE DYNAMICS CALCULATION.

KITAWAKI, T., TOKUYASU, T., OKA, H.

KANSAI MEDICAL UNIVERSITY, FUKUOKA INSTITUTE OF TECHNOLOGY, OKAYAMA UNIVERSITY

Introduction
In order to evaluate bicycle pedaling skills, it is important to describe the usage of the trunk muscles, such as iliacus muscle and major psoas muscle which is related to the role to lift the lower extremities. We have developed a device that can accurately measure crank angular velocity and pedaling posture(1), and try to evaluate trunk muscles force during bicycle pedaling using inverse dynamics calculations. There are few studies have shown a relationship between pedaling skills and the force of the trunk muscles during the bicycle pedaling. Accordingly, estimation of trunk muscle force during the pedaling may be beneficial for pedaling skills training. In this study, we therefore intended to estimate the trunk muscle force using actually measured value of the pedaling force, pedaling posture and crank angle under various conditions using inverse dynamics calculations.
Methods
We use reacting force (pedal force, saddle force and handle force) from the bicycle to the subject, and pedaling action (pedaling posture, crank angle), obtained from a measurement system. A participant was given the pedaling load (100W and 250W) by bicycle trainer, with specified cadence (60rpm, 90rpm) and pedaling technique (sitting, dancing). Using crank angle obtained from the measurement system, the reacting forces of the bicycle were averaged at crank angle (every 2 degree) at each pedaling condition. Using the averaged value of pedal force and pedaling action data vary with crank angle, inverse dynamics calculations have been performed by commercially available software (AnyBody). Surface muscle force using electromyogram (EMG) was used in order to evaluate the accuracy of the computations.
Results and Discussion
Inverse dynamics calculation results was obtained using the all forces (not only pedal force but also saddle force and handle force) and real pedaling action (such as dancing) which were difficult to take in the past model. We were able to calculate the activity of trunk muscles which used to lift the lower extremities. From the inverse dynamics calculation result, muscular activity changes can be compared with measured EMG values. These results agreed well for some muscles; however, some muscles have different muscular active timing. The muscular activities have higher agreement when dancing than sitting. This may be due to the fact that the point of application of saddle force is not stay a single point.
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Contact
kitawaki@hirakata.kmu.ac.jp

INCREASE IN WORKRATE BY CADENCE PRODUCES GREATER GROSS EFFICIENCY WITHOUT IMPROVING PEDAL FORCE EFFECTIVENESS

KAMBA, M., NAITO, H., KATAMOTO, S., OZAKI, H., MACHIDA, S.
JUNTENDO UNIVERSITY

Introduction
Maximizing the mechanical efficiency (gross efficiency : GE) is an important consideration for competitive cyclists to achieve successful race performance. One factor that may determine GE is the amount of tangential force applied to the crank arm. The index of pedal force effectiveness (IFE), which is the ratio of tangential force to resultant force of pedaling, has been used to evaluate one's pedaling competence since there is a positive relationship between GE and IFE. Generally, GE increases with workrate accompanied by increase in IFE (up to approximately 300 W) when cycling at a given cadence, implying that greater GE is explained by improved IFE. These findings were established in both ergometry (incremental load) and field conditions (changing to high gears) (Stig et al. 2009). However, the effects of workrate on GE and IFE remains unknown when workrate is intensified by pedaling cadence. Given a previous study showing that IFE decreased with cadence during a constant workrate cycling (Stig et al. 2011), we hypothesized that such cadence effects would alter the GE and IFE responses to incremental workrate from what had been previously observed. This study, therefore, investigated the GE and IFE during cycling on the rollers at varying workrates, with pedaling cadence, rather than pedaling load or gears, manipulating the workrate.
Methods
Nine male collegiate cyclists (age: 20.4±1.7 yr, height: 170.8±4.7cm and body mass: 64.1±5.4kg) performed an incremental cycling test using a road racing bicycle on the rollers with a constant friction load. The pedaling workrate was initially set at 100W, and then stepwisely increased by 50 W up to 300W, comprising 5 stages × 4-min pedaling with 1-min of light pedaling between stages. The cadence was increased accordingly to produce the workrate required for each stage. IFE and energy expenditure during exercise were measured using commercially available pedaling monitoring system and automatic respiratory metabolism device, respectively. GE was calculated as the ratio of work done to energy consumption during each stage.
Results
GE increased linearly with workrate, which was, however, not accompanied by increase in IFE. IFE was rather stable across the workrates tested.
Discussion
When workrate is increased by cadence, the resulting increase in gross efficiency may not be attributable to improved index of pedal force effectiveness.
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VALIDATION OF FITBIT CHARGE HR WEARABLE PHOTOPLETHYSMOGRAPHIC HEART RATE DEVICE DURING REST AND SUBMAXIMAL INCREDMENTAL CYCLING

SANDERSON, M.1, MARR, R.1
1. INSTITUTE FOR CLINICAL EXERCISE & HEALTH SCIENCE

Introduction
Heart rate (HR) is a very common physiological measure used in both research and exercise in general populations. Recent technological advances have included portable and relatively inexpensive wrist worn devices which utilise photopletysmography to record HR. However there is a lack of validation research comparing these devices with more traditional chest worn HR devices which have previously shown good reliability against the criterion methods of HR recording (Engström et al, 2012). The purpose of this study was to examine the validity of Fitbit Charge HR in comparison to Polar V800 recorded during rest and submaximal incremental cycling in recreationally active participants.
Methods
Twenty participants were recruited, 5 females (22.8 ± 2.39years, 163.84 ± 4.49cm, 66.1 ± 8.04kg) and 15 males (21.8 ± 0.94years, 182.83 ± 4.14cm, 81.27 ± 11.87kg). Participants wore Fitbit Charge HR and Polar chest transmitter devices following manufacturers instructions; during a period of supine rest and incremental cycling (90-210W). Intra-class Coefficient Correlation (ICC) and Bland & Altman mean differences and 95% limits of agreements (LoA) were completed.
Results
Fitbit demonstrated strong ICC with Polar for HR collected during rest only ($p < 0.01$, mean difference of -1.5 bpm). At all other exercise intensities; ICC was not significant. At lower exercise intensities (90W) a mean difference of -32.8 bpm, (95% LoA 11.4, -77.0) between Fitbit and Polar HR data was found. However, at higher exercise intensities (120; 150; 180; and 210W), the mean difference increased: -41.7; -45.0; -44.3; and -36.3 bpm respectively, (95% LoA: 13.5, -96.9; 18.5, -108.4; 26.2, -114.9; and 41.8, -114.4 respectively).
Discussion
Fitbit Charge HR may be a valid measure for recording resting HR; however this particular photoplethysmographic device appears to underestimate HR data collected during incremental cycling. Large mean differences and LoA were found with cycling intensities compounding this inaccuracy. This is in agreement with previous literature validating Fitbit Charge HR with criterion HR measures (Jo et al, 2016). Reasons to account for the main findings require further research but are likely to involve the manner by which the device is worn on the wrist, as well as obvious differences in measuring HR via photoplethysmographic versus chest transmitter mechanisms. Fitbit Charge HR failed to meet acceptable validity for the exercise protocol completed and caution should be used if measuring HR data via this device during submaximal cycling.
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THE EFFECTS OF CYCLING AND RICE BERRY CONSUMPTION ON CREATINE KINSASE AND MUSCLE PAIN SCORE

SILALERTDETKUL, S.
SRINAKHARINWIROT UNIVERSITY

Introduction
Creatine kinase is an enzyme associated with muscle damage. It had been demonstrated that circulating creatine kinase concentrations were elevated following exercise. Interestingly, rice berry contains a lot of vitamin E, beta carotene, omega-3, and polyphenol. However, the effects of rice berry consumption on muscle damage still unclear. Therefore, the objective of this study was to investigate the effect of rice berry consumption compare with white rice on creatine kinase relate to muscle pain score.
Methods
Twelve males age between 20 and 22 years participated in this study, which had been approved by the local ethics committee (body mass index, 23+ 3 kg/m2; percent body fat, 18+ 8 %; total fat mass, 13 + 6 kg; total fat free mass, 54+ 6 kg; resting heart rate, 67+9 beat/min; systolic /diastolic blood pressure, 115± 12/71±8 mmHg; maximum oxygen consumption, 49 ± 5 ml/kg/min: mean ± SD). This experiment was cross-over design with two main trials separately by at least 14 days. On one occasion participants consumed rice berry .On another occasion they were consumed white rice. Participants were also asked to cycling for one hour at 80% maximum heart rate 90 mins following consumption either rice berry or white rice. Venous blood samples were taken at the baseline, 30, 60, 90, 150, 180 mins in both trials. Creatine kinase concentrations, muscle pain score, and rate of perceived exertion were measured over period of time. The data were analyzed using two way repeated measures ANOVA and paired t-test.
Results
Two way repeated measure revealed no trial and time interaction but there was a time effect of creatine kinase, muscle pain score, and rate of perceive exertion ($p<0.026$). Creatine kinase was increased significant at immediately following exercise in white rice trial ($p=0.001$) and its tended to be increased in rice berry trial ($p=0.06$) when compared with before exercise. Muscle pain score was elevated at 30, 60, and 90 mins following exercise in two trials ($p<0.001$). There was a significant increase in rate of perceive exertion at 30 and 60 mins following exercise in both trials. Rate of perceive exertion at 90 mins in white rice trial also higher than the baseline ($p=0.029$).
Discussion
Although there was no difference in creatine kinase, muscle pain score, and rate of perceive exertion between two trials. However, creatine kinase, muscle pain score, and rate of perceive exertion following consumption of rice berry tended to be lower than consumption of white rice.

Mini-Orals

MO-PM23 Functional movement and injury prevention

FUNCTIONAL MOVEMENT SCREENING TO DETERMINE RISK OF INJURIES AND LOCOMOTOR SKILL PERFORMANCE IN YOUNG TRACK ATHLETES

PUCSOK, J. M.1., TATÁR, A.1, TARNÓCZY, Z., BALOGH, L.1
(1): UNIVERSITY OF DEBRECEN

Introduction
The Functional Movement Screening (FMS) consists of seven exercises, which measures individual movement assymetries, unbalances in certain movements executed in both sides in a 0-21 scale. The poor biomechanical movement patterns may be identified, thus corrected with special physical exercise programme (Cook, 2013). Implementing efficient movement strategies, may significantly reduce the risk of injuries (Chorba et al. 2010). Use of FMS scores may improve the quality of the training programme, thus overall performance (Butler, 2011).
Methods
Thirty young elite track athletes (age 16-23) was volunteered to take part in our examination. Male and female sprinters, long and high jumpers represented local clubs in Hungary, Slovakia and Rumania
We formulated a questionnaire which stresses on five areas of injuries typical to track athletes, which are the hip, the hamstrings, the knee, the ankle, and the Achilles tendon areas of the body. Also we established a five to one scoring system to identify the status of injuries from healthy (5) to surgical procedure was made (1). After that, a complete FMS testing was done, later a standing long jump test was executed by the participants.
Results
We were trying to establish any significant relationship between FMS scores and actual motor performance by executing standing long jump test - the status of prior (within two years) injuries were taken into account.
In this particular population we have not found significant relationship - the correlation coefficient was rather low – between total FMS scores (group average was 14.6) and standing long jump performance, also we could not establish stronger correlation between FMS scores and overall scores (5 to 1) of injury status.
Discussion
In the related literature we found numerous studies, (www.functionalmovement.com), which established strong correlation between FMS scores and injury risk. We suggest, that the higher the FMS score is (above 14), the lower the risk for any injuries, thus the better the sport performance (Butler, 2013).
In the future, we are planning to separately retest a larger scale population, male and female track and ball sport athletes. Also we are ready to broaden our perspective and further examine the relationship between FMS scores and the actual sport performance, FMS scores and the methods and techniques of the rehabilitation process, FMS scores and the ways and tools of physical preparation. Age, history of injuries, sporting experience, fitness level of the subjects must taken into account in all cases.
Contact
pucsok73@gmail.com

THE RELATIONSHIP BETWEEN FUNCTIONAL MOVEMENT SCREEN SCORE AND INJURY IN HIGH SCHOOL WOMEN'S VOLLEYBALL PLAYERS.

IDE, Y.

KYUSYU UNIVESITY OF NURSING AND SOCIAL WELFARE

Introduction

Volleyball requires dynamic movement, which included jumping, landing, spiking, reception, and digging. Dynamic sports specific tasks increase the risk of injuries. Previous studies shows, in volleyball, the ankle is the most common injured body region followed by the knee (Reeser et al., 2015; Bere et al., 2015). To prevent injuries, athletic trainers perform evaluation, which included Functional Movement Screen® (FMS) to measure movement quality (Cook, 2010). FMS is one of the well-known screening tools to identify the athletes' movement pattern that provides us each athlete's physical characteristics and abilities. Therefore, the purpose of this study was to identify the relationship between FMS composed score (CS; range, 0-21), each movement pattern score (range, 0-3), and injured region.

Method

Forty-one high school women volleyball players, without a current history of injures, completed Functional Movement Screen® (FMS), which consists of seven fundamental movement patterns testing athletes' mobility, stability, and coordination, prior to a competitive season (Cook, 2010). Injury report was made by the certified athletic trainer during in-season practice and competition. Unpaired Student's t tests and Mann–Whitney U-tests were used to compare, and $p < 0.05$ was regarded as significant.

Result

The knee (35%) was found the most frequently injured region, followed by the ankle (28%), the lower back (10%), and the shoulder (10%). The mean of FMS CS with the knee injury was 11.7 and uninjured was 13.8, which had 2.1 differences (p=.003, g=1.15[.39, 1.90]). The mean of deep squat (DS) score with the knee injury was 1.1, whereas uninjured was 1.7 (p=.026, g=.84 [.10, 1.57]). The mean of rotary stability (RS) score with the knee injury was 1.2, whereas uninjured was 1.9 (p=.018, r=.37).

Discussion

The movement of DS required mobility and stability in multiple lower extremity joints, which required by most of sports. Moreover, the movement of RS also required lower extremity joints movement as well as postural control, which included core coordination with an appropriate transfer of energy through the trunk (Chimera et al., 2015; Clifton et al., 2015). In our study, FMS score might actually reflect lower extremity injuries rather than upper extremity injuries. It is suggested that to correct lower extremity movement pattern contributes to reducing the risk of injuries.

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Contact

yukowh@kyushu-ns.ac.jp

INTER-TESTER RELIABILITY OF OVERHEAD SQUAT ASSESSMENT USING 2D MOTION ANALYSIS

BATHIA, K., DAVIS, F., MANE, N., VARADHRAJULU, G.

KRISHNA INSTITUTE OF MEDICAL SCIENCES DEEMED UNIVERSITY

Introduction

One of the most common risk factor for lower extremity injuries include biomechanically impaired movement patterns. These high-risk patterns result in irregular musculoskeletal stresses and increase the risk of sustaining overuse and noncontact lower extremity injuries during sports.Overhead squat has been commonly usedin laboratory and clinical settings to find the impaired lower extremity movement patterns and identify individuals potentially at risk for injuries. It is commonly usedby National Academy of Sports Medicine (NASM) as an outcome tool but has no numerical grading system to quantify the measures. It outlines specific movement dysfunctions at the major joints in the kinetic chain and provides suggestions to minimize the effects of these movement dysfunctions.Thus stating a need to analyze overhead squat using joint angles and distance measures.

Methods

50 athletes including 29 males and 21females from age group of 18 to 40 years involved in either recreational or competitive sports were included. Athletes with conditions which can result in decreased range of motion at neck, shoulder and back were exclude. Athletes performed overhead squat five times and it was recorded using two video camera simultaneously from anterior and lateral view by the first rater. The two raters then individually analyzed the squat using Kinovea freeware motion analysis software.

Results

Excellent inter-rater reliability was found using Pearson's correlation co-efficient in the anterior view for toe out angle (0.995, 0.946), knee distance (0.984,0.978) and shoulder distance (0.954, 0.965) measures bilaterally. In the lateral view the reliability was found good to excellent for shoulder flexion (0.958), hip flexion (0.719), knee flexion (0.926) and ankle dorsiflexion (0.970) measures.

Conclusion

The inter rater reliability of overhead squat assessment using 2D motion analysis is sufficient to encourage clinicians in using overhead squat as a simple and a reliable outcome measure to address the impaired movement patterns in athletes.

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Contact

bathiakhushboo@gmail.com

DIFFERENCE IN THE EMG ACTIVITY OF HAMSTRING MUSCLES DEPENDING ON THE KNEE FLEXION ANGLE AND KINETIC CHANGE

HIROSE, N.1, TSURUIKE, M.2

1. WASEDA UNIVERSITY (TOKYO, JAPAN), 2. SAN JOSÉ STATE UNIVERSITY (CALIFORNIA, USA)

Introduction
The electromyography (EMG) activity of semitendinosus (ST), semimembranosus (SM), and biceps femoris long head (BFl) varies depending on the knee flexion angle in open kinetic movement, such as prone leg curl exercise (Onishi et al., 2002). However, those muscle activities in closed kinetic movement, such as supine hip lift, which often performed in an athletic training setting are still unclear. Thus, we aimed to clarify the difference in EMG activity of hamstring muscles during open- and closed- kinetic movement across difference knee angles and power output.
Methods
Sixteen male young active healthy volunteers were tested. They performed hip lift both leg (HLB), single leg (HLS) and the isometric prone leg curl with 20% (LC20) and 40% (LC40) of their maximum voluntary isometric contraction (MVIC). EMG activities of ST, SM, BFl, gluteus maximus (GM), and erector spinae (ES) were measured in each of the exercises. This study randomly set 30, 60, 90, 120 deg of knee flexion for each of the exercises. Each of the EMG activities was standardized by MVIC at 90 deg of knee flexion during the prone position (iEMG). We compared a difference in iEMG of each muscle at LC20, LC40, HLB, and HLS across 4 different knee flexions using two-factorial ANOVA, followed by Tukey's post-hoc test at the alpha level of 5% ($p<0.05$).
Results
The significant interaction was obtained in SM, BFl, and ST ($p<0.05$). The iEMG of SM, BFl and ST significantly differed across different knee flexion angles ($p<0.05$); the iEMG of SM and BFl was greater at 30 and 60 deg of knee flexion than 90 and 120 deg, whereas ST exhibited a contrary trend in LC20, LC40, HLB, and HLS. iEMG of ES in HLB and HLS at 30 deg knee flexion angle was greater than any other knee flexion angles ($p<0.05$). No difference of iEMG in GM was observed, regardless of exercises or joint angles.
Discussion
ST had the different muscle activity pattern from SM and BFl in both open and closed kinetic movement. It is speculated that this tendency was due to the different anatomical architecture, such as fusiform or bipennate muscle, and kinematic characteristics, such as a moment arm (Lu and O'Connor, 1996). The findings of the activity difference in each hamstring muscle can be implicated to considering the strengthening of the hamstring muscles.
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Contact
toitsu_hirose@waseda.jp

CROSS-SECTIONAL COMPARISON OF AGE-RELATED CHANGES OF THE QUADRICEPS FEMORIS IN BASKETBALL PLAYERS

SEKINE, Y.1,2, HIROSE, N.2

1:NIPPON SPORT SCIENCE UNIVERSITY, 2:WASEDA UNIVERSITY

Introduction
The quadriceps femoris (QF), which plays a key role in human movement, is an important muscle for basketball players because jump height and acceleration in short sprint, which reflect the power generated in the lower extremity, are important factors in basketball performance. Previous studies reported that muscle heads, which constitute QF, possess original functions (Toumi et al., 2007). However, the extent of the differences in growth of the subdivided QF among different age groups is unknown. Therefore, the purpose of the present study was to examine the age-related changes of the QF in basketball players.
Methods
Seventy Japanese male elite basketball players (aged 12–20 years) volunteered to participate in this study and were divided into 4 groups according to age (12–13, 14–15, 16–17, and 18–20 years). The muscle thicknesses (MTs) of the vastus medialis oblique (VMO), vastus medialis (VM), rectus femoris (RF), vastus intermedialis (VI), and vastus lateralis (VL) were measured in the dominant leg by using real-time ultrasonography. Cross-sectional images were obtained and analyzed using a software. The MTs of the VMO, VM, RF, and VL were compared among the age groups by using one-way analysis of variance followed by Tukey's post hoc test. The MTs of VI had a non-normal distribution and were compared by using the Kruskal-Wallis test followed by the Bonferroni post hoc test.
Results
Significant interactions among the age groups were observed for all subdivided QF muscles ($p<0.01$–0.001, $\eta 2=0.21$–0.37). In the 12 to 13 year age group, all MTs of subdivided QF were significantly lower than those in the 18 to 20 year age group ($p<0.01$–0.001, $d=1.21$–1.84). Significant differences in MT, except for VMO and VI, were found between the 12 to 13 year and 16 to 17 year age groups (VM: $p<0.001$, $d=1.37$; RF: $p<0.001$, $d=2.43$; VL: $p=0.007$, $d=1.15$). The MTs in VM, RF, and VI in the 14 to 15 year age group were significantly lower than those in the 16 to 17 year (VM: $p=0.007$, $d=1.12$; RF: $p=0.026$, $d=1.10$) and 18 to 20 year age groups (VM: $p<0.001$, $d=1.54$; RF: $p=0.036$, $d=0.79$; VI: $p<0.001$, $d=1.47$).
Discussion
Muscle mass increases from approximately 46% to 54% of body weight between ages 13 and 17.5 years (Malina et al., 2004). Our results showed notable growth of the QF at ages 16–17 years and age-related differences in maturation rate of QF in each muscle head. The differences in function among the muscle heads might influence the differences in growth rate.
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Contact
yyy.s.444@gmail.com

LOWER LIMB ALIGNMENT AND FLEXIBILITY ASSOCIATED WITH KNEE ABDUCTION MOMENT AND ANGLE DURING SINGLE-LEG LANDINGS AND HOP & SIDESTEP

SATO, S.1, KAGAYA, Y.1,2, TSURUIKE, M.2

1:SHOWA UNIVERSITY (YOKOHAMA, JAPAN), 2:SAN JOSE STATE UNIVERSITY (SAN JOSE, USA)

Introduction
Increased knee abduction moment and angle during movements such as landings and side-step cutting are suggested to be a risk factor for an anterior cruciate ligament (ACL) injury. A number of contributing factors have been reported to reduce knee abduction moment and angle. However, the relationship between lower limb function and increased knee abduction moment or angle doesn't have just one point of view (Cronstrom et al., 2016). There is a need for an understanding lower limb function that contributes to increased knee abduction moment and angle. The purpose of this study was to investigate the correlation of lower limb function and knee abduction moment and angle during single-leg landings (SLL) and hop & sidestep (HSS).
Methods
Twenty-seven male and female university students (53 legs) participated in this study. Their mean age was 20.3 ± 4.4 years, height and weight were 167.4 ± 8.7 cm and 60.3 ± 10.7 kg. Subjects were measured for lower limb function (range of hip internal/external rotation, range of ankle dorsiflexion, thigh foot angle (TFA), Q-angle, and navicular drop). Additionally, subjects performed a minimum 3 trials of SLL and HSS on their both legs. This procedure was recorded using a three-dimensional motion analysis system (Vicon-MX) operating a 250Hz, and two force platforms for ground reaction forces on 1,000Hz. The Pearson correlation coefficient were used to explore relationships between lower limb function and knee abduction moment and angle during SLL and HSS.
Results
During SLL, peak knee abduction moment was found to be significantly correlated with TFA ($p < 0.01$, $r = 0.513$). Peak knee abduction angle was also found to be significantly correlated with TFA ($p < 0.02$, $r = 0.323$). During HSS, peak knee abduction angle was found to be significantly correlated with TFA ($p < 0.01$, $r = .398$) and Q-angle ($p < 0.05$, $r = .296$).
Discussion
Little has been reported on relationship between TFA and knee abduction. This study indicated that increased TFA correlated with knee abduction moment during SSL and knee abduction angle during SSL and HSS. Previous study reported that peak knee valgus during the single leg squat and static knee valgus were not significant greater in the high Q-angle group compared to the low Q-angle group (Pantano et al.,2005). Our study indicated that Q-angle correlated with knee abduction angle during HSS. It is useful to understand the factors of increased knee abduction moment and angle.
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Contact
shohei.sato.830@gmail.com

THE EFFECT OF UPPER LIMB EXHAUSTIVE ACTIVITY ON CORTICOSPINAL EXCITABILITY AND MOTONEURON POOL RESPONSIVENESS OF LOWER LIMB

GHARAKHANLOU, R., KAVEHY, A., AMIRY, E., RAJABI, H.

TARBIAT MODARES UNIVERSITY

Introduction
The aim of the present study was to investigate the effect of upper limb exhaustive activity on corticospinal excitability and motoneuron pool responsiveness of lower limb.
Methods
Ten active male (age: 28.1 ± 2.99 years, body height: 1.77 ± 4.1 cm, ody mass: 75.7 ± 4.98 kg) available and volunteered to take part in this study and reported to the laboratory on three different occasions. After measuring anthropometric features and familiarization with the pull up and stimulations in the session one, in the second and third visits, motor evoked potential (MEP) , cervicomedullary motor evoked potential (CMEP) and maximum direct motor response (Mmax) were assessed immediately, 10 and 20 minutes after the protocol fatigue by the use of magnetic stimulation over the motor cortex and spinal routes and electrical stimulation of peripheral nerve, respectively.
Results
Our results by the use of one-way repeated measures ANOVA showed a significant decrease in MEP tibialis anterior muscle (uninvolved) immediately ($p=0.001$) and after 10-minute ($p=0.001$) the protocol compared to resting values. CMEP and Mmax did not show significant change relative to resting values ($P= 0.38$, $P= 0.09$).
Discussion
Based on data obtained looks at phenomenon of spread fatigue from upper limb to lower, supraspinal centers involved. Moreover, this supraspinal fatigue considerable time needed for recovery.

PREVALENCE AND RISK FACTORS OF MTSS IN PETE STUDENTS

BLIEKENDAAL, S., FOKKER, Y.M., PLOMP, S., STUBBE, J.H.

AMSTERDAM UNIVERSITY OF APPLIED SCIENCES

Introduction
Medial Tibial Stress Syndrome (MTSS) is one of the most common overuse injuries in the lower extremities. MTSS often leads to long lasting complaints and reduced ability to participate in sport activities. This study aims to investigate the prevalence of MTSS and risk factors associated with MTSS in Physical Education Teacher Education (PETE) students.
Methods
A prospective study design was used. All subjects were first year PETE students and were followed from September to December 2016. Prior to the start all students underwent a physical screening which consisted of the following tests: the navicular drop test, hip external and internal range of motion (ROM), hip adduction and abduction strength, shin palpation for edema and pain, 3000 meter run test, and measurement of body height and weight. During the follow-up period students filled out a MTSS score questionnaire (scale: 0-10, with 0

as the lowest and 10 as the highest severity score) every 5 curricular weeks. The association between risk factors and MTSS injury risk was assessed using univariate logistic regression analysis for dichotomous variables (gender, MTSS history, shin pain, shin edema) and an independent samples t-test for continuous variables (navicular drop, height, weight, fat percentage, running performance, hip ROM, hip strength).
Results
A total of 257 subjects with a mean age of 19.6 (SD=2.2) for men (N=219) and 18.8 (SD=1.5) for woman (N=70) participated in this study. Preliminary results demonstrated a prevalence of MTSS of 7.2% prior to the start of the year. During the follow-up period prevalence increased to 15.7%. The average severity score was 2.4 (SD=2.1). At the end of the follow-up period 23.3% (N=60) of the PETE student suffered from MTSS.
The following factors were associated with MTSS: gender (women; OR=3.1, CI=1.6-5.7, p<.01), a history of MTSS (OR=8.6, CI=3.9-18.9, p<.01), pain at shin palpation (OR=2.7, CI=1.4-5.1, p<.01), and shin edema (OR=2.6, CI=1.3-5.9, p<.01). Significant differences between the MTSS and non-MTSS groups were found in the navicular drop (p<.01) and body height in men (p<.05). No significant differences were found for age, BMI, body length for women, body weight, fat percentage, 3000 meter running performance, hip exorotation ROM, hip endorotation ROM, hip abduction strength, and hip adduction strength.
Discussion
The prevalence of MTSS in PETE students is relatively high. Relevant risk factors are gender (women), a history of MTSS, shin pain at palpation, shin edema, navicular drop, and body length in men. These factors can be used to improve screening methods for identifying PETE students at risk for MTSS.

Mini-Orals

MO-SH05 Social sciences: mixed session

WHY DO YOU COME TO PRACTICE? A QUALITATIVE STUDY OF MEMBERSHIP RETENTION IN A GERMAN SPORT-FOR-ALL VOLLEYBALL CLUB

ZAVADSKA, A., GIEL, T.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
There is an ongoing problem with recruitment and retention of members in sport clubs in Germany and since volleyball is also not the most popular sport in Germany (Petry & Hallmann, 2014), the challenge to keep young volleyball players in a sport club becomes extremely difficult. Little research has been conducted on how to retain members within a sport-for-all club as most research focuses on performance-oriented clubs or business entities.
Methods
A qualitative, exploratory research approach was chosen to find out what makes youth volleyball players that are members of a German sport-for-all club to come to practice as well as what the club can do to retain those players as members. 8 youth volleyball players from a Cologne-based sport-for-all club were interviewed and provided right insight into their behavior. Furthermore, the refined Sport Commitment Model by Scanlan et al. (2009) was adapted and a conceptual model of practice attendance and membership retention in a sport-for-all club was developed.
Results
The findings of this study show that the reasons why youth volleyball members of a sport-for-all volleyball club come to practice are because they want to have fun while playing with people they feel comfortable with and can use practice as distraction from everyday life and improve individually.
Discussion
The strategies that German sport-for-all clubs should use to retain its members need to focus on: (1) providing adequate number of players per team; (2) good coaching; (3) good equipment; (4) gym locations within the proximity of members' school and house; (5) (good) communication through social events; (6) implementing member feedback; (7) attracting members through word-of-mouth; and (8) organizing events at local volleyball facilities. Future research should focus on using longitudinal studies with many measurement points to provide a thorough comparison of reasons why adolescents retain their membership and how managers of sport-for-all clubs can attract more members.

THE INFLUENCE OF EGO DEPLETION ON SPORTING PERFORMANCE: A META-ANALYSIS

XIANG, M.Q., LI, L.M., HU, M.
GUANGZHOU SPORT UNIVERSITY

This meta-analysis examined the effect of ego depletion, as well as potential moderators, on sporting performance. A search of relevant literature in both Chinese and English databases yielded a total of 31 papers (n = 1613 participants), which were all included in the meta-analysis. The results revealed that: (1) There was a moderate effect of ego depletion on sporting performance (d = 0.55, 95% CI [0.39, 0.71]), although this might be overestimated due to publication bias. (2) The effect of ego depletion on sporting performance was not moderated by the type of participant or sporting task, but was moderated by the type of ego depleting task and stress manipulation used. (3) There was no significant effect found for ego depletion on subjective perceived exertion, heart rate, or EMG activation in the sporting tasks. These findings support the generalizability of Baumeister's Strength Model of Self-Control, as well as its integration with Eysenck and colleague's Attention Control Theory. Future research should attempt to standardize the experimental conditions employed, and explore interventions designed to mitigate against ego depletion effects in sport.

CROSS-NATIONAL RELATIONS BETWEEN THE SOCIAL SIGNIFICANCE OF SPORT AND ECONOMIC DEVELOPMENT IN THE EUROPEAN UNION.

NADER, M.

UNIVERSITY OF VIENNA

Introduction
Sport plays an important role in different areas of European societies (economy, health, education, politics, tourism, media). To operationalize the social significance of sport in the 28 member states of the European Union, Weiß et al. (2016) developed an indicator-based statistical benchmarking model: the European Sport Index. Based on this index, the present study analyses the relationship between the social significance of sport and the economic development in the 28 members of the EU.
Methods
By means of a comprehensive desk research, a set of important economic indicators was identified: the Gross Domestic Product per capita in Purchasing Power Standards (GDP-PPS), the Human Development Index (HDI) and the Global Competitiveness Index (GCI). Beside content-related considerations, the availability, actuality and comparability of the data were crucial criteria for the selection of the indicators. To this end, the data was drawn from various international databases (Eurostat, United Nations Development Programme, World Economic Forum). Pearson's correlation coefficient (r) was calculated to examine the relations between the European Sport Index and the selected economic indicators. Additionally, the correlations between the sub-indicators were investigated in order to gain a deeper understanding of these associations.
Results
Strong positive correlations between the European Sport Index and the economic indicators were found (GDP-PPS: r=0,737; HDI: r=0,753; GCI: r=0,788; $p < 0,05$). In particular, northern and western European countries (e.g. Germany, Denmark, Netherlands) reach higher scores on the European Sport Index and the economic indicators. Countries from southern and eastern Europe (e.g. Bulgaria, Romania, Lithuania), on the other hand, score lower on all observed indicators.
Discussion
The identified macro-level correlations highlight that in economically higher developed countries, sport plays a more important role. However, deeper research needs to be done to analyze causality and robustness of these correlations.
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CHANGES OF SPORTS FOR ALL IN KOREA

NAM, Y.

DUKSUNG WOMEN'S UNIVERSITY

Introduction
Korea is a country where elite sports have developed. The Olympic Games have consistently ranked in the top 10 in the world (www.Sports.or.kr). Like this, the elite sport is emphasized in Korea. And relatively, sports for all are politically less supported by the government. However, it is true that the participation rate of the physical activity of the people has been increased recently because sports for all are emphasized as the important part of the sports policy of Korea. The purpose of this study is to examine the changes in participation in sports in Korea and to propose a policy to increase the participation rate of sports in the future.
Methods
Data from the Ministry of Culture, Sports and Tourism survey on participation in the national sports were recycled. The subjects of this study were 9,000 Korean people. The subjects were 728 men and 647 women in their teens, 706 men and 792 women in their 20's, 789 men and 792 women in their 30's, 851 men and 854 women in their 40's, 676 men and 711 women in their 50's, 398 men and 453 women in their 60's, 295 men and 477 women over the age of 70.
Results
The percentage of 'never doing exercise' is 51.8% in 2012, 34.5% in 2014, 34.4% in 2015 and 29.5% in 2016. Participation in the exercise 2-3 times a month is 5.0% in 2012, 10.8% in 2014, 9.6% in 2015 and 11.0% in 2016. Participation in the exercise once a week is 8.3% in 2012, 11.2% in 2014, 10.6% in 2015 and 11.0% in 2016. Participation in 2-3 times a week exercise is 18.0% in 2012, 22.9% in 2014, 23.2% in 2015 and 29.2% in 2016. The percentage of participating in 4-5 weekly exercises is 10.6% in 2012, 11.1% in 2014, 12.6% in 2015 and 14.4% in 2016. The 6th week will be 2.3% in 2012, 4.0% in 2014, 2.5% in 2015 and 2.5% in 2016. The daily average is 4.0% in 2012, 5.5% in 2014, 7.2% in 2015 and 3.1% in 2016. The percentage of participants participating in the exercise more than once a week is 43.3% in 2012, 54.8% in 2014, 56.0% in 2015, 59.5% in 2016, 35.0% in 2012, 43.5% in 2014, 45.3 percent, and 49.3 percent in 2016.
Discussion
The percentage of people who do not exercise at all is gradually decreasing, and the proportion of Koreans participating in the exercise is increasing. The most popular sporting events in Korea were walking, followed by mountain climbing and bodybuilding.
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contact
younshinkr@duksung.ac.kr

RESEARCH ON APPLICATION OF INSTITUTIONAL REPOSITORY IN NATIONAL FITNESS

XINHUA, L., QI, C., ZENLIANG, M., HAN, Z., ZHUANGCHENGDONG, L.

CHINA INSTITUTE OF SPORT SCIENCE

Introduction

Aim of this paper is to discuss how to apply institutional repository to national fitness programs, and provide repository-level support and service to national fitness.
Methods
Through referring to literature material and other methods, this paper gathered large amount of domestic and overseas literature materials about IR and national fitness, and discussed IR's application in national fitness.
Results
Definition of institutional repository: Through analysis of abundant literature materials, this paper holds that, IR is a knowledge service system for academic institutions to capture, save, file, organize, process, and manage intellectual products created by their members, and provides open access, so as to realize the aim of permanent storage and wide spread for these digital objects. It can realize open access and long-term storage of digital resource at different degrees, promote academic exchange, and lift institutions' academic status.
Aim of IR's application in national fitness: The aim is to enable PE teachers and sport researchers to create and formulate personalized exchange policy according to their own exchange need; it should also meet with worldwide sport experts' demand for direct and fast exchange and communication. Meanwhile, it can also provide the body builders with relevant fitness instructions, suggestions, evaluations and strategies, etc.
Conditions for IR's application in national fitness: The conditions include specificity in subject, technicality in content, permanency in preservation, interoperability in searching, openness in operation and free of charge in acquisition.
Outlook for IR's application in national fitness: it's hopefully to realize function enrichment, organization federalization (Zhao et al., 2010), storage in cloud (Lyon et al., 2006), and service intellectualization (Chen et al., 2012).
Discussion
Only by complying with the development need of extensive environment, sticking to features of the new-generation IR and further making its development goal clear, can a clear understanding be got for its development tendency in the future (Deng et al., 2009) and let it give play to its role in supporting digital scientific research and knowledge exchange in extensive national fitness, so that it can make active contribution to our life and health by providing good knowledge service and sharing.
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Contact
1520833260@qq.com

SEDENTARY BEHAVIOUR AMONG SAUDI BASKETBALL PLAYERS

ALAHMADI, M.
TAIBAH UNIVERSITY

Introduction
Sedentary behaviour affects health and performance in highly trained athletes. A number of researches have demonstrated that physical activity and sedentary behaviour are two independent entities. However, sedentary behaviour in highly trained athletes in Saudi Arabia has not been determined. Therefore, the aim of this study was to assess sedentary behaviour in Saudi Basketball players.
Methods
16 basketball players (mean ± SD, age, 22.6±3.3 years; body mass, 77.8±10.5 kg; height, 182.9±10.8 cm) participated in this study. A self-report sedentary behaviour questionnaire was used to assess time spent in watching television, computer/internet use, electronic games playing, and total sedentary time.
Results
93.7% of basketball players spent more than 2 hours per day in sedentary activities. On average, the total amount of time spent in sedentary activities was 455±218 min/day. Computer/Internet use was the most predominant sedentary behaviour among basketball players (186±114 min/day).
Discussion
These findings indicate that athletes spent significant amounts of sedentary behaviour. Therefore, sedentary behaviour still exists in highly trained athletic people.

ACTIVE HEALTHY KIDS BELGIUM 2016 REPORT CARD ON PHYSICAL ACTIVITY FOR CHILDREN AND YOUTH

SEGHERS, J.1, WIJTZES, A.1, DE RIDDER, K.2, CLOES, M.3, MOUTON, A.3, VERLOIGNE, M.4, CARDON, G.4
1. KU LEUVEN, 2. BELGIAN SCIENTIFIC INSTITUTE OF PUBLIC HEALTH, 3. UNIVERSITY OF LIEGE, 4. GHENT UNIVERSITY

Introduction
This 2016 Belgium Report Card on Physical Activity for Children and Youth is the first systematic evaluation of physical activity behaviors, related health behaviors, health outcomes, and influences thereon, using the Active Healthy Kids Canada grading framework.
Methods
A research working group as well as policy experts from both Flanders and Wallonia collaborated to determine the indicators to be graded, data sources to be used, and factors to be taken into account during the grading process. Grades were assigned based on examination of the current data and literature for each indicator against a benchmark or optimal scenario: A (81-100%) = We are succeeding with a large majority of children; B (61 – 80%) = We are succeeding with well over half of children; C (41 – 60%) = We are succeeding with about half of children; D (21 – 40%) = We are succeeding with less than half, but some, children; F (00 – 20%) = We are succeeding with very few children; INC = there is no or insufficient evidence to assign a grade. In addition to an overall grade, an indicator could be assigned a plus sign or minus sign based on the presence or absence, respectively, of substantial social inequalities, according to age, region, gender, or socioeconomic status.
Results
Eleven indicators were selected and assigned the following grades: overall physical activity (F+), organized sport participation (C-), active play (C+), active transportation (C-), sedentary behaviors (D-), school (B-), government strategies and investment (C+), and weight status

(D). Incomplete grades were assigned to family and peers, community and the built environment, and dietary behaviors due to a lack of nationally representative data.
Discussion
Despite moderately positive social and environmental influences, physical activity levels of Belgian children and youth are low while levels of sedentary behaviors are high.

Mini-Orals

MO-SH07 Mental health and psychological wellbeing

THE EFFECTS OF A 6-MONTH SCHOOL-BASED HIGH-INTENSITY INTERVAL TRAINING INTERVENTION ON MENTAL WELL-BEING AND QUALITY OF LIFE IN CHILDREN

EDDOLLS, W.T.B., MCNARRY, M.A., WINN, C.O.N., WADE, N.D., MAKINTOSH, K.A.
SWANSEA UNIVERSITY

Introduction
Exercise has been suggested as a strategy to address the increasing prevalence of anxiety and depression during childhood, which has doubled in the last 25 years (Collishaw et al., 2010) with 20% of adolescents (World Health Organization, 2003) now likely to experience mental health problems. Given the sporadic nature of children's movement patterns and short concentration spans high intensity interval training (HIIT) has been advocated as a potential health-enhancing tool. However, evidence is currently contradictory regarding the influence of high-intensity activity on mental well-being. Therefore, the purpose of this study was to assess the effect of a 6-month HIIT intervention on mental well-being in children.
Methods
Eighty participants (12.78±1.09 years; 45 boys) took part in the study, with 27 (15 boys) randomised to an intervention group, who completed a 6-month school-based HIIT intervention (3x30 min, 10-30 s exercise bouts at >90% age-predicted heart rate, followed by equal rest), and 53 (30 boys) to a control group. Measurements were taken at baseline, 3-months, post-intervention and follow-up. Anxiety and depression were assessed using the Generalised Anxiety Disorder Assessment (GAD-7) and the Center for Epidemiologic Studies Depression Scale for Children (CES-DC), respectively.
Results
No significant intervention effects were found at any time point: GAD-7 ($F(2.6,0.14)=1.56$, $P=0.92$), CES-DC ($F(3,0.31)=14.47$, $P=0.82$) and PedsQL ($F(3,1.29)=82.34$, $P=0.28$). Eta-squared from baseline to follow-up reported a small-to-medium effect size for PedsQL ($\eta p2=0.02$), but a very small effect size for GAD-7 and CES-DC ($\eta p2<0.01$). Whilst not significant, all measures improved at post-intervention compared to baseline.
Discussion
Given the well-documented physiological benefits elicited by HIIT, the present findings provide further support for HIIT as a time-effective tool to enhance child health, refuting previous studies suggesting that vigorous intensity activity is associated with negative mental health outcomes. Future studies should investigate whether modifications to HIIT protocols could be optimised to elicit enhanced mental well-being.
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HOW PERCEPTION OF GREEN AND RED ENVIRONMENTS INFLUENCE THE DYNAMICS OF PREFERRED WALKING AND RUNNING PATTERNS

MAJED, L., AL-DOSARI, M., MAHMOUD, M., MARASSTANI, S., BAYOUMY, N., BRIKI, W.
QATAR UNIVERSITY

Introduction
The complex interaction between human biological system and colored environments may give rise to perceptions and meanings that may precipitate the appearance of affects, cognition and behaviors (Briki et al., 2016). Colors can be characterized in terms of appetitive (green) and aversive (red) cues that have been associated with approach and avoidance motivational system, respectively (Elliott & Maier, 2007). Research mostly investigated relationships between colors and feelings (Briki & Hue, 2016), while motor behaviors have received little attention from color psychologists. As a result, the aim of this research was to examine whether perceiving green and red environments affects the most natural forms of human locomotion, preferred walking (Study 1) and running (Study 2) patterns.
Methods
Healthy young female adults volunteered in two studies (Study 1, N=29; Study 2, N=29) and were randomly assigned to one of three experimental groups (green, red, or white environment). Experiments started with a 10-min warm up/familiarization on the treadmill after which a 20-min walk (Study 1) or run (Study 2) trial was performed at the most comfortable speed. The treadmill was surrounded (front and sides) by three 60" HD TVs displaying specific visual properties (HSV) of one of the three colors. At the beginning of each of the four 5-min intervals of the test, participants freely selected their preferred gait speed (PGS). At the last minute of each interval, heart rate (HR) and self-reported measures of perceived exertion (RPE), pleasure (PL), and arousal (AR) were recorded. To reduce potential discriminatory factors, normalized PGS (n-PGS) were computed as relative to the participants' leg length.
Results
Results revealed a significant main effect of Color on n-PGS [$p=.044$] and HR [$p=.047$], where values were significantly lower only for walking (Study 1) in the green environment compared to the white one. Other variables were not affected by the experimental conditions for both studies.
Discussion
The results suggest that perceiving green while walking would encourage the human organism to slow down, and this may be due to the relaxing effect of green (Briki & Hue, 2016), thereby leading the organism to preserve its energy. However, such an effect was not

confirmed when participants ran, suggesting that running would involve more intense physiological and locomotor control, thereby reducing the sensitivity of the organism to environmental stimuli.
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Contact
lina.majed@qu.edu.qa

PARENTS DEMANDS FOR JUNIOR TENNIS PLAYERS - EXPERIMENTAL STUDY

MOSOI, A. A
TRANSILVANIA UNIVERSITY OF BRASOV

Introduction
Parental involvement in the game of tennis has attracted a strong interest from researchers (Hill et al., 2009; Harwood & Knight, 2009; Murray et al., 2012). Advices for coaches, accessing information from the virtual environment, emotional involvement and financial investment in their children's game are the nowadays challenges faced by parents of future tennis players. Our experimental study aims to analyze the perception of tennis players according to expectantly understanding with their parents and coaches.
Methods
This study was conducted on a group of 35 athletes, from the international junior ranking (ITF ranking), age 15.6 years, SD 1.2 years. Athletes were asked about claims based on a parent's questioner on their results and how to understand with their personal trainers.
Results
The Manova results indicated significant differences between the performance of athletes (place in international rankings) a medium level of their claims indicated high results in international ranking ($F [2.34] = 4.42$ ($p < .01$), higher level of demands on athletes indicate lower results in international ranking ($F [2.34] = 3.21$ ($p < .05$). In the same direction, athletes who get along well with their coaches have significantly higher performance ($F [2.34] = 7.6$ ($p < .01$) compared with those athletes who get along well or less well with coaches ($F [2.34] = 2.1$ ($p \geq .01$). These results indicate a moderate pressure of parents for athletes with high performance, in comparison with other athletes.
Discussion
Parents are trying by any means to offer their children the best conditions for training and preparation in order to achieve some notable performances, but all these potential opportunities are available in the athlete's perception? If the parents will provide optimal training conditions, athletes will play the best tennis?
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Corresponding author
alex2mos@yahoo.com

OVERVIEW OF THE RELATIONSHIP BETWEEN PSYCHOLOGICAL STRESS AND BACK PAIN AMONG ATHLETES

HEIDARI, J.1, HASENBRING, M.1, KLEINERT, J.2, KELLMANN, M.1,3
1: RUHR UNIVERSITY BOCHUM, 2: GERMAN SPORT UNIVERSITY COLOGNE, 3: THE UNIVERSITY OF QUEENSLAND

Introduction
Risk factors for back pain (BP) in athletes are predominantly associated with biomechanical and movement-related aspects in research, whereas stress-related psychological factors have scarcely been considered, as psychological stress appears to be a significant issue in the related context of injury occurrence and return from injuries, the role of stress should be scrutinized for BP (Wiese-Bjornstal, 2010). The present review article aimed at the elaboration of three different facets:
(a) Provision of a conceptual differentiation between BP and injury; (b) Synopsis of research obtained in the field of stress-related psychological factors and injuries; (c) Synthesis findings from injury research with the state-of-the-art evidence of stress-related psychological factors for BP among athletes.
Methods
The primary intention consisted in the conduction of a systematic literature scan. The databases PubMed, MEDLINE, PsycINFO, PsycARTICLES, Academic Search Premier, and SportDiscus were searched for suitable studies using different combinations of search terms. Due to the lack of existent studies in the field of stress-related psychological factors for BP in athletes, we focused on a literature review describing the present research.
Results
A significant overlap between the ideas of injury and BP exists. Nevertheless, subtle and essential differences between the concepts were established based on existing definitions. Injuries originate from a physical cause, thereby representing a criterion which is often lacking in the diagnosis of BP (Timpka et al., 2014). Four studies including the issue of psychological stress for BP among athletes were detected, with two studies specifically focusing on longitudinal approaches.
Discussion
Stress-related psychological factors and BP delineate a well-established association in the working population which remains insufficiently explained among athletes. This literature review may initiate future research focusing on the relationship between psychological stress, BP, and athletes. Subsequent studies may involve convincing methodological designs allowing for directional evidence regarding the complex health issue BP in the athletic population.
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Contact

jahan.heidari@rub.de

COMPARISON OF NON-PEN AND PAPER AND NON-INVASIVE PSYCHOLOGICAL STRESS MEASUREMENT METHODS IN SPORTS THROUGH A METAANALYSIS– ARE THERE RELIABLE?

BALOGH, L., PUCSOK, J., NAGY, A., MOLNÁR, A., PETROVSZKI, Z.

UNIVERSITY OF DEBRECEN

Introduction
The aim of this study is to find an objective way to measure one of the well-researched topics in sport psychology, the stress and the anxiety. Thereby determine the most reliable methods. According to several researchers the many times used methods are the pen and paper tests or questionnaires (eg. STAI, CSAI, STAI-FX, etc.) and the very few times used non invasive ways (salivary cortisol, EGIG, etc.). However, the question is that how can we measure the stress trustworthy. The pen and paper tests are standardized and broadly accepted methods despite of its based on mostly introspection. The psychophysiological based measurement ways seem much more independent of the subjective factors of the examined person. Our main goal is to compare the types of psychological stress measurement methods in sports, through a wide metaanalysis, based on famous scientific database.
Methods
To reach our main goal we used some of the most famous databases (e.g. pubmed, researchgate, springer, elsevier, sciencedirect, googlescholar, sportdiscus, taylor and francis, etc.). We looked for the keywords „stress and/or anxiety measurement" in sports. We compare the results, in point of view the methods, the main goals, the participants, the reliability and the results/conclusions of authors in more than 200 publications. We examined only the after 2000 published research.
Results
We found that there are very few methods for the stress/anxiety measurement! Until this day, in sport sciences and mostly in sport psychology, the researchers well-liked the pen and paper tests (1), and adhere to it. There are a very few innovative, new, psychophysiology based methods, as the neuroendocrine system ACTH, Cortisol (in animal Corticosteron), enzymes like alpha amylase (2), and last one, the gastrointestinal motility based EGG, or EGIG (3). Our results proved that the cardiology based (e.g. HRV) methods for measurement to psychological stress are not accurate and valid and depend on a lot of variables.
Discussion
Comparison to the last year examinations, from the 2000 year, we proved that the sports and exercise can handle the measurement of psychological stress. However, we could find that despite of nowadays we have a very broad aspect of innovative technology and methods of stress measurement in sports, the most part of researchers use very few of it yet. In our point of view we offer the psychophysiological based methods like salivary or EGIG rather than only pen and paper tests. The new methods are capable to measure the stress level in sports and based on our examinations we find that much more reliable, too.

CHOKING AT THE FREE-THROW LINE: ELITE PLAYERS HAVE THEIR SAY

MAHER, R., MARCHANT, D., MORRIS, T.

VICTORIA UNIVERSITY

Introduction
Despite the accumulation of knowledge regarding the underlying mechanisms and antecedents of choking in sport few researchers have sought explanations and solutions directly from elite players.
Methods
In the current study, we drew on the collective experiences of seven professional basketball players, using in-depth semi-structured interviews, to explore how choking is understood and managed at the upper echelon of basketball participation.
Results
The results were thematically analysed and comprised of six emergent themes: choking definition, antecedents, personality, automaticity, mental skills, and management strategies.
Discussion
We discuss the findings, especially from the knowledge, transfer and exchange perspectives in specifically reducing susceptibility to choking and recommend strategies for basketball coaches.

SALIVARY TESTOSTERONE REACTIVITY, ANXIETY, AND PERCEIVED PERFORMANCE IN ELITE YOUTH BASKETBALL PLAYERS: THE EFFECT OF OPPONENT LEVEL

MOREIRA, A., ARRUDA, A.F.S., PALUDO, A.C., DRAGO, G., AOKI, M.S.

UNIVERSITY OF SÃO PAULO

Introduction
The Biosocial Model of Status (BMS; Mazur, 1985) postulates that an increase in testosterone concentration (T) would be observed in individuals competing for high status within a given hierarchy. BMS also predicts a competition effect (e.g. increased T in winners). However, the role of contextual factors in regulating T responses has yet to be elucidated. This study examined the effect of playing matches against different opponent levels on T reactivity (pre-to-post change), anxiety, and players' perceived performance.
Methods
Thirty elite male basketball players (U-15, U-16, and U-17) volunteered for this study. Pooled data from 2 winning matches for each age-category, played at home, for each opponent level condition (easy, EM; moderate, MM; and hard, HM) were analysed. Saliva sampling was conducted before and after the matches. Pre-match anxiety was assessed (CSAI-2). The session-RPE and perceived performance were registered after the matches. The variation in T (%) was compared to a zero baseline (t-test for single means). An ANOVA-repeated measures was used to examine the differences between conditions on T change ($\alpha \leq 5\%$; Bonferroni test as post hoc). The Friedman test was used to examine anxiety and self-confidence scores (Wilcoxon with Bonferroni´s adjustment as post hoc). Effect sizes (ES) were computed to compare players' perceived performance and session-RPE between conditions.
Results
A significant T change was observed for all match conditions. A lower T reactivity was verified for HM (vs EM and MM). In addition, a higher cognitive and somatic anxiety was observed for HM (vs EM) with no difference for self-confidence. A higher session-RPE was

observed for HM (vs EM; moderate ES = 0.30); and a lower perceived performance was verified for HM (vs EM; ES =-0.23, and vs MM; ES = -0.29).
Discussion
The lower T reactivity and perceived performance for HM suggest that contextual factors besides competition outcome may affect T response (Zilioli et al., 2014), and that post-match rise in T may depend on the participants' performance evaluation (Gonzalez-Bono et al., 1999). Close outcomes, as observed in the HM, may cause the status hierarchy to become unpredictable, which might explain the lower perceived performance aligned with the lower T reactivity. Even elite youth players get more anxious and tend to perceive a higher psychophysiological demand facing a more challenging opponent.
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Contact
alemoreira@usp.br

15:00 - 16:00

Mini-Orals

MO-PM25 Exercise and training in disease

ENDOTHELIAL FUNCTION AND PHYSICAL ACTIVITY IN HEALTHY VS CORONARY ARTERY DISEASE AND COPD PATIENTS: AN EXPLORATORY STUDY

BERNARDI, E., CORNELLISEN, V., GRAZZI, G., MERLO, C., VANHEES, L., COGO, A.
UNIVERSITY OF FERRARA

Introduction
The importance of physical activity both in healthy individuals and chronic patients is well known. In particular, regular exercise reduces the risk of cardiovascular events and improves endothelial dysfunction that is an early event in the pathogenesis of cardiovascular diseases. The gold standard for the measurement of the endothelial dysfunction is the flow-mediated dilatation (FMD). The aims of the study were:
1. To compare endothelial function of 3 groups of subjects: healthy individuals, patients with coronary artery disease (CAD) and patients with chronic obstructive pulmonary disease (COPD).
2. To evaluate the effect of physical activity, HDL and spirometry on FMD.
Methods
77 males: 32 healthy (age 70±5 yrs); 27 CAD (age 70±6 yrs) and 18 COPD (age 71±6 yrs) were included. Outcome measures: FMD, spirometry, physical activity (PA) by ambulatory monitoring (SenseWear Armband) and lipid profile (blood sample). ANOVA tests were applied to examine differences between groups.
Results
COPD patients were less active (number of steps: 5725±2859, 7738±3252 and 9424±3608 respectively for COPD, CAD and healthy; p=0.007) and smoked more than CAD patients and healthy controls (packs/year: 34±18, 16±16 and 15±17 respectively for COPD, CAD and healthy; p<0.001). After adjustment for smoking and PA, FMD was significantly lower in both patient groups compared to healthy controls (FMD: 3.59±0.47, 5.47±0.59 and 7.45±0.45 respectively for CAD, COPD and healthy; p<0.001). Furthermore COPD had a better FMD compared to CAD (Pairwise comparisons, p=0.04). In the total group a significant correlation was found between number of steps, METS and FMD (r=0.36, p=0.006; r=0.27, p=0.03 respectively for number of steps and METS) and between HDL and FMD (r=0.36, p=0.007). No correlation was established between FMD and the severity of airflow obstruction.
Discussion
Endothelial function is impaired in chronic diseases but in CAD patients is worse than in COPD. These preliminary data confirm the importance of an active life style on the early cardiovascular impairment. These results should now be confirmed in a larger study.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE AND PHYSICAL ACTIVITY: A NEW METHOD TO ASSESS EXERCISE LIMITATIONS.

MERLO, C., BERNARDI, E., CONFORTI, P., MUNARI, L., SORINO, N., COGO, A.
UNIVERSITY OF FERRARA

Introduction
Exercise limitation is the major cause of disability in COPD patients and it is mainly due to alterations in breathing mechanism. Dyspnea is the primary symptom in COPD contributing to the degree of disability. The ventilatory limitation during exercise is related to both expiratory flow limitation and dynamic hyperinflation. The breathing reserve (BR) is reduced and the perception of dyspnea increased. Besides pharmacological intervention, a regular physical activity avoiding sedentarism is the most effective treatment. The most established and easy test to measure exercise capacity is the 6-min walk test (6MWT). The ventilatory analysis during the 6MWT can be an useful and simple tool to better understand the causes of exercise limitation in COPD. Currently, a new medical device is available for the measurement of ventilation, breathing pattern and oxygen saturation (SpO2) during 6MWT (Spiropalm®, Cosmed). The aim was too investigate the respiratory responses and evaluate factors limiting the exercise capacity in COPD during the 6MWT.
Methods
87 mild to severe COPD (60 M, 27 F), age 43-83 years, performed a forced flow-volume curve and the 6MWT using the Spiropalm®, therefore assessing ventilation and ventilatory pattern, SpO2 and heart rate. The BR is calculated by the instrument as the difference between maximal voluntary ventilation (MVV=FEV1x 0,40) and maximal ventilation reached during the test. Furthermore, 24 out of 87

patients worn for 7 days a metabolic Holter (SenseWear® Armband) to analyze the physical activity on daily life: energy expenditure, duration and level of physical activity and number of steps.
Results
Results are expressed as mean±SD.
Most subjects were inactive (number of steps 6869±3524). During 6MWT: walk distance was 375±108 m; dyspnea was 5±2/10 of the Borg Scale; oxygen desaturation (ΔSpO2= SpO2 at baseline–SpO2min) was 4±3%. Walking distance was significantly correlated to: BR ($r=0.53$, $p<0.01$), ΔSpO2 ($r= -0.32$, $p<0.002$), dyspnea Borg perception ($r= -0.399$, $p<0.0001$) and number of steps ($r=0.75$, $p<0.0001$).
Conclusion
The 6MWT with the analysis of ventilation is a simple and useful tool to discriminate between the possible causes of exercise intolerance in COPD patients, as evidenced by the correlation between walk distance and BR.
The importance of keeping an active lifestyle is emphasized by the positive correlation between the 6 minute walk distance and daily number of steps.

EFFECT OF NEUROMUSCULAR ELECTRICAL STIMULATION TRAINING WITH PULMONARY REHABILITATION ON BALANCE IN PATIENTS WITH COPD.

TRABELSI, Y., MEKKI, M., PAILLARD, T., TABKA, Z.

SOUSSE FACULTY OF MEDICINE

Introduction
Knowing that loss of muscle strength is one of the major factors affecting balance and the chronic obstructive pulmonary disease (COPD) reduces physical activity and subsequently functional capacity, it seems then important to investigate neuromuscular electrical stimulation (NMES) effects on balance and exercise tolerance of patients with COPD. Therefore, the aim of this study was to analyze the effects of NMES combined in pulmonary rehabilitation (PR) on exercise tolerance and balance in COPD patients.
Methods
Patients were randomly assigned to either a PR group (n=20) that received a standard program including 72 sessions (3 times per week for 6 months) or a PR+NMES group (n=25) that additionally received NMES (20 min) after each session of the standard program. Balance was assessed by Stabilometric platform in eyes open (EO) and eyes closed (EC), Time Up and Go (TUG) and Berg Balance Scale (BBS) tests. Exercise tolerance was determined using a 6-Minute Walking Test (6MWT) and the maximal voluntary contraction (MVC) was measured with an ergometer. All of these measurements were assessed before and after the training period.
Results
NMES included in PR engendered a better effect on static and dynamic balance and exercise tolerance as well as a greater improvement in MVC in patients with COPD than PR alone. NMES of lower-limb muscles should be implemented in the PR of COPD as it induces better improvement in static and dynamic balance likewise in exercise tolerance and could reduce falls in patients with COPD
Discussion
The greater improvement of MVC founded in the PR+NMES group than in the PR group could be explained by the increase in muscle strength related to the NMES applying. The 6MWTD improvement after NMES+PR was significantly higher than the 6MWTD after PR. Muscle strength improvement could be the reason of the variability of the walking distance between the two groups since the workload that matches the walking activity would be weaker for the PR+NMES group than for the PR group. The centre of pressure (CoP) in the mediolateral direction and the CoP area were significantly improved in both groups ($P<0.001$) in EO and EC. The CoP in the anteroposterior direction was improved ($P<0.001$) only in the PR+NMES group in EO and EC. Both groups showed a significant decrease in TUG values ($P<0.001$), a significant increase in BBS values ($P<0.001$) and a significant increase in MVC ($P<0.001$) after training. The TUG, BBS and MVC outcomes were significantly greater in the PR+NMES group than in the PR group ($P<0.05$; $P<0.01$; $P< 0.001$, respectively). The postural balance improvement may attribute to force increase in lower limb muscles and the walking distance improvement in the PR group and the NMES+PR group.
Contact
trabelsiyassine@yahoo

IS THERE AN ASSOCIATION OF EARLY REPOLARIZATION SYNDROME WITH MIGRAINE? ATHLETE'S SCREENING TESTS RESULTS

RADZISHEVSKY, E., TANCHILEVITCH, A., BERDICHANSKY, L., ROSENSCHEIN, U., GOLDHAMMER, E.

BNEI-ZION MEDICAL CENTER

Introduction
ERS describes two different ECG morphologies: 1) a benign form characterized by anterior ST elevation and 2) a potentially malignant, arrhythmogenic form which involves infero-lateral J waves followed by a horizontal or downsloping ST segment. ERS prevalence among general population is 1-3%, increasing significantly to 5-16% among blacks, younger individuals (<40 years), and athletes. It is considered a cardiac channelopathy, potassium channelopathy in particular. The aim is to assess possible clinical entities association with early repolarization syndrome (ERS) in athlete's pre-participation tests.
Methods
The pre-participation tests of 917 athletes, 615 males & 302 females, age 8-36y, performed in our hospital sport clinic 1.1.2015 – 1.12.2016 were analyzed retrospectively. Age, gender, individual health questionaires, family history of sudden cardiac death (SCD) <40 y, applicant diseases and medications, ECG & exercise test indices were analyzed.
Results
102 (16.6%) of males had ERS pattern compared to 28 (9.3%) in females, $p<0.01$, family history of SCD found in 3 applicants only, all alleged to coronary disease, Epilepsy was reported in 2 cases, and Migraine was reported by 21 female athletes (7%), none among males ($p<0.001$). Migraine was found in 9 (32.1%) of female athletes with ERS.
Discussion
Migraine prevalence in the general population is 15-18%, more common in women, usually by a factor of 2:1, occurring more often between the ages 35 – 55y, while in our female athlete group, with ERS, in particular, it was much higher, a group which is younger compared to the general women population suffering from migraine. Both ERS and Migraine are considered to be channelopathies and recent studies suggest that mutations in genes encoding for potassium channels and their subunits play a role in their pathophysiology.

Conclusions: Significant association was found between ERS and migraine in female athletes. Whether the common denominator is in a similar gene mutation should be further investigated.

FUNCTIONAL STATUS IMPROVES WITH ANGIOTENSIN CONVERTING ENZYMES INHIBITORS PLUS EXERCISE IN HYPERTENSIVE OLDER ADULTS

BAPTISTA, L.C., MACHADO-RODRIGUES, A.M., MARTINS, R.A.

COIMBRA UNIVERSITY

Introduction
Pharmacological interventions with angiotensin converting enzyme inhibitors (ACEi) have been associated with clinical benefits on physical function in hypertensive adults. However, it has been suggested that the benefits may only occur when ACEis are combined with exercise training (EX), but this issue remains controversy. Therefore, the aim of the present study is to analyze the effect of three types of treatment on functional status, and health related quality of life in hypertensive older adults with comorbidities.
Methods
These 2-year un-randomized longitudinal cohort study included 418 hypertensive older adults (> 60 years) that underwent one of the following 3 conditions: i) multicomponent exercise training 3 times/week (EX; n = 116); ii) angiotensin converting enzyme inhibitors used mono-dose daily (ACEi; n = 70); iii) combined exercise and ACEi medication (ACEi+EX; n = 232). Baseline and follow-up evaluations included the Senior Fitness Test battery (Rickli & Jones, 1999), Short Form Health Survey 36 (SF-36)(Ferreira, 1998) and the health history questionnaires.
Results
The EX and ACEi+EX improved all physical functional status outcomes (P<0.001) and augmented the physical functioning, role physical and physical component score (PCS) (P<0.05), but also bodily pain (P<0.05). The ACEi group diminished the upper body strength, upper and lower body flexibility and aerobic endurance (P<0.05); and decreased general health and PCS (P<0.05).
Discussion
This study demonstrated that chronic use of exercise training combined with ACEi medication produce significant improvements in the functional status, particularly in upper and lower body strength, and in aerobic endurance in independently hypertensive older adults with comorbidities. Additionally, long-term ACEi mono-dose isolated therapy does not prevent functional status decline and, reversely, may even augment physical disability through decreases in upper body strength, in upper and lower flexibility, and in aerobic endurance capacity. Hypertensive older adults with independently functional status using ACEi medications may benefit from adopting an exercise training regimen, promoting physical functioning and ultimately HRQoL.
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EFFECTS OF 6-MONTH RESISTANCE TRAINING ON PHYSICAL FITNESS IN PANCREATIC CANCER PATIENTS

CLAUSS, D., TJADEN, C., SCHNEIDER, L., HACKERT, T., STEINDORF, K., WISKEMANN, J.

GERMAN CANCER RESEARCH CENTER

Introduction
It is well known that regular exercise improves physical fitness in patients with various cancer entities. However, such studies in pancreatic cancer patients are lacking. Therefore, we assessed the feasibility and effect of 6-month resistance training on muscle strength and cardiorespiratory fitness in pancreatic cancer patients within a randomized controlled intervention trial.
Methods
In total, 65 pancreatic cancer patients were enrolled and randomized into three groups (supervised progressive resistance training EX1, home-based resistance training EX2, usual care control group CG). Both exercise groups performed resistance training two times per week for about one hour over 6 months. Maximal voluntary isometric contraction (MVIC) and maximal isokinetic peak torque (MIPT; 60°/s) for extension and flexion of knees, elbows, and hip as well as cardiorespiratory fitness were assessed before, during and after the intervention. Differences among the groups were analyzed based on linear mixed-models adjusting for baseline value.
Results
Out of the 65 patients 47 patients completed the intervention period. Patients attend in 59% of the prescribed training sessions while those who completed the intervention, attendance rate were 59% (EX1) and 78% (EX2). Completer showed significant improvements in MIPT for arm flexion (EX1: +6.3Nm, 95%CI [2.7, 9.8], KG: +0.6Nm, 95%CI [-2.3, 3.4]; ß 5.5; p-value group differences p= 0.01) and extension (EX1: +7.0Nm, 95%CI [3.1, 10.9], KG: +0.7 Nm, 95%CI [-2.4, 3.8]; ß 6.5; p= 0.01) for EX1 compared to CG as well as compared to EX2 (arm flexion: +1.8Nm, 95%CI [-0.7, 4.3]; ß 4.3; p= 0.04, arm extension: +1.7Nm, 95%CI [-1.1, 4.4]; ß 5.5; p= 0.02). For MVIC of knee extension significant improvements could be observed for EX1 (EX1: +13.5Nm, 95%CI [-4.5, 31.6], KG: -17.9Nm, 95%CI [-32.8, -3.1]; ß 34.5; p= 0.0048) and EX2 (+2.4Nm, 95%CI [-10.2, 15.0]; ß 20.7; p= 0.04) compared to CG. For cardiorespiratory fitness there were significant improvements in maximal work load (W) for EX1 compared to CG (EX1: 19.1Nm, 95%CI [8.8, 29.3]; ß 15.6; p= 0.02).
Discussion
We demonstrated that resistance training in pancreatic cancer patients was feasible. Muscle strength was improved through regular resistance training and supervised training seemed to be more effective than home-based resistance training.
Contact
Dorothea.Clauss@nct-heidelberg.de

EXERCISE PRESCRIPTION TO IMPROVE CLINICAL PRACTICE ON CANCER PATIENTS SUFFERING CHEMOTHERAPY-INDUCED PERIPHERAL NEUROPATHY UNDERGOING TREATMENT: A SYSTEMATIC REVIEW.

VENDRAMIN, B., DUREGON, F., BULLO, V., GOBBO, S., CASTIGLIONI, G., ZACCARIA, M., BERGAMIN., M., ERMOLAO, A.

UNIVERSITY OF PADOVA

Introduction

This document aims to summarize and analyze systematically the current body of evidence about the effects of specific exercise protocols on physical function, balance control and quality of life in patients with peripheral neuropathy (PNP) induced by chemotherapy.
Methods
Systematic Review
Literature survey
Specific terms were identified for the literature research in MEDLINE, Scopus, Bandolier, PEDro, and Web of Science. Only studies published in peer-reviewed journals written in English language were considered. Four manuscripts were classified as eligible with 88 total participants, with an average of 57.1 years old. Quality appraisal classified two studies as high quality investigations while two with low quality. Results were summarized in the following domains: "CIPN symptoms", "Static balance control", "Dynamic balance control", "Quality of life and Physical function".
Results
Specific exercise protocols were able to counteract common symptoms of chemotherapy-induced peripheral neuropathy (CIPN) during chemotherapy treatments. Significant improvements were detected on postural control. Additionally, patients' quality of life and independence were found ameliorated after exercise sessions, together with reductions on altered sensations and in other peripheral neuropathy symptoms. Combined exercise protocols including endurance, strength and sensorimotor training showed larger improvements.
Conclusions
Exercise prescriptions for cancer patients undergoing chemotherapy with CIPN symptoms should be recommended since these exercise interventions appeared as feasible and have been demonstrated as useful tools to counteract some common side effects of chemotherapeutic agents.

REGULAR PHYSICAL ACTIVITY IN CHRONIC HEMODIALYSIS PATIENTS: EFFECTS ON DIURNAL PATTERN OF STEROID HORMONES.

GALLOT, M., GANEA, A., COLLOMP, K., VIBAREL-REBOT, N., RIETH, N.

CIAMS

Introduction
Chronic renal diseases need dialysis treatment which has many side effects on patients. We notice a decrease in quality of life (Finkelstein et al., 2009), hormone release disorders (Raff et al., 2012), appetite and sleep disturbances (Mitch, 2002; Murtagh et al., 2007), and an inflammation marker increase (CRP: C-reactive protein) (Barany et al., 2012).
Health benefits of physical activity in hemodialysis patients are well-documented (Labadens et al., 2014). But, to our knowledge, little data are available on the effect of physical activity on hormonal circadian rhythm.
Methods
Fifteen hemodialysis patients were distributed into two groups: TP group that engaged in an intradialytic resistance band exercise training program (Bullani et al., 2011) three times a week during 3 months (N: 8, age: 56.5 ± 17.24 years, weight: 89.26 ± 11.10 kg) and NTP group that not engaged in training program (N: 6, age: 57 ± 12.88 years, weight: 69.17 ± 9.35 years). Blood and salivary samples were collected at the beginning and at the end of the study. Three-day food diaries, appetite and sleep disturbances questionnaires are also used. Salivary samples were collected six times a day to observe cortisol and DHEA (dehydroepi-androsterone) circadian variations.
Results
The main expected result is an improve circadian rhythm of hormonal release. The unusually high level of cortisol during the night (Raff et al. 2012) may decrease. The regular physical activity could also contribute to the maintenance of the DHEA level, which decreases faster in hemodialysis patients than in healthy people (Kakiyo et al., 2012). Moreover, we expected a decrease in inflammation marker and in sleep disorders in TP group patients.
Discussion
The improvement of cortisol and DHEA diurnal pattern, in response to physical activity, will preserve patient autonomy and enhance quality of life by reducing sedentary lifestyle.
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Contact
gallot.melanie@yahoo.fr

BALANCE IMPAIRMENT IN KIDNEY TRANSPLANT RECIPIENTS WITHOUT CONCURRENT PERIPHERAL NEUROPATHY.

GOBBO, S., ZANOTTO, T., BULLO, V., VENDRAMIN, B., DUREGON, F., BERGAMO, M., ZACCARIA, M., BERGAMIN, M., ERMOLAO, A.

UNIVERSITY OF PADOVA

Introduction
Kidney transplant recipients (KTRs) present with an overall compromised functional capacity, low levels of physical activity, muscle atrophy, and peripheral nerve dysfunction that may result in high postural instability (McAdams-DeMarco et al., 2015). Therefore, this study aimed to compare the static balance control of KTRs with healthy adults (HA).
Methods

19 KTRs and 19 HA underwent the Romberg test on a stabilometric platform with eyes open (EO), eyes closed (EC) and during a dual task (DT) condition. Velocity-based centre of pressure (COP) measures, COP velocity (COPv) and sway area (SA), as well as position-based outcomes such as anterior-posterior (AP) and medio-lateral (ML) ranges of COP displacements were taken for the account.
Results
Independent comparisons, by means of ANCOVA, showed an overall lower performance of KTRs compared to HA ($p < .05$). The EC condition determined the worse performance for KTRs, suggesting a poorer capacity of relying on proprioceptive information when maintaining the upright posture. The addition of a cognitive task did not result in a worse balance performance in KTRs.
Discussion
An impaired postural control is one of the main predictors of falls in elderly subjects, and might also represent a risk factor for falling in middle-aged KTRs.
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A TAILORED PHYSICAL ACTIVITY INTERVENTION AND EXERCISE PRESCRIPTION TO IMPROVE CLINICAL PRACTICE FOR ONCO-HEMATOLOGY INPATIENTS

DUREGON, F., CASTIGLIONI, G., BULLO, V., GOBBO, S., VENDRAMIN, B., BERGAMIN, M., ERMOLAO, E., ZACCARIA, M.
UNIVERSITY OF PADUA

Introduction
Therapy of hematological malignancies persists for a long time and involves in various complications. The main consequences of chemotherapy are fatigue and forced bed rest, due to immunodeficiency secondary to the treatment that, in turn, also contributes to in impairment of physical efficiency. Physical activity and structure exercise programs can prevent this weakening through the improvement of aerobic capacity and muscle strength, thus this investigation aimed to determine the beneficial role of exercise in the maintenance of the physical function in onco-hematology inpatients.
Methods
The study included onco-hematology patients, who were administered a tailored exercise protocol during their hospitalization. Intervention was mainly focused for the development of strength and flexibility; exercise sessions were directly performed in the patients' own hospital room. Exercise program was supervised by an Exercise Specialist and driven by audio-video support. Intervention group was compared with control group, which remained physically inactive for all period of hospitalization.
Results
The intervention group did not show significant decreases during hospitalization period. Significant changes were found in flexibility performance and in balance control ($p <0.05$). On the contrary, strength had a significant decrease in the control group.
Discussion
Results from this investigation showed that a tailored exercise protocol administered to hospitalized onco-hematology patients is feasible and efficient to promote the maintenance of their physical function. Moreover, results indicated a beneficial effect of the exercise counteracting side effects of chemotherapy treatments with a concurrent reduction in bed rest syndrome.

Mini-Orals

MO-PM07 Performance Testing

TEST-RETEST VARIATION AND ENERGY CONTRIBUTION DURING ANAEROBIC CAPACITY TESTING

AREZZOLO, D.1, BYRNE, N.M.2, COFFEY, V.G.1
1 BOND UNIVERSITY, AUSTRALIA. 2 UNIVERSITY OF TASMANIA, AUSTRALIA.

Introduction
Anaerobic capacity tests determine non-aerobic pathway contributions during a single bout of supramaximal exercise (>VO2max) performed to volitional fatigue. Understanding the variability in estimates of energy contributions from anaerobic capacity tests is needed to better understand anaerobic performance and the effectiveness of training strategies in enhancing anaerobic capacity. This study determined test variability and anaerobic energy contribution of the maximal accumulated oxygen deficit (MAOD) test.
Methods
Nineteen men (mean ±SD: 28 ±6 y, VO2peak 50 ±7 ml·kg-1·min-1) undertook four experimental trials of cycling to fatigue (Excalibur Sport, Lode) at a power output equivalent to 120% VO2peak, after an overnight fast and separated by a minimum 48 h recovery. Anaerobic energy contribution was calculated as the difference between O2 demand and uptake (1) from respiratory data averaged every 15 s (Quark, Cosmed). Test-retest reliability was determined using coefficient of variation (CV) with 95% confidence intervals (CI), change in mean with 95% limits of agreement (LOA), and intraclass correlation coefficient (ICC).
Results
The mean anaerobic capacity during each trial was 61.1, 60.5, 62.2 and 61.6 ml·kg-1. Change in the mean ±LOA between each sequential pair of trials was -0.9 ±20, 2.7 ±14 and -0.8 ±15%, respectively. The CV values were 5.7 (CI: 3.5 – 7.8), 4.4 (2.9 – 6.0) and 4.4% (3.1 – 5.8) and ICC values were 0.64, 0.81 and 0.84. Mean time to fatigue (TTF) for each trial was 185, 185, 196 and 193 s, with CV values of 8.5 (5.8 – 11.3), 7.5 (4.1 – 10.8) and 6.3% (4.4 – 8.3). The mean anaerobic energy contribution during each trial was 35, 34, 33 and 33%, respectively. The change in mean anaerobic contribution ±LOA was -2.3 ±17, 3.2 ±23 and 0.6 ±21%, with CV of 5.1 (3.4 – 6.9), 6.5 (3.8 – 9.2) and 5.9% (3.8 – 7.9) and ICC of 0.65, 0.48 and 0.66.
Discussion
Variability in measures of anaerobic capacity, assessed via CV and LOA, decreased between experimental trials 1 and 2 but not subsequent trials. However, the increase in mean anaerobic capacity and TTF between trials 2 and 3 indicate positive systematic bias due to a learning/training effect. This finding would suggest that to decrease test variability in determining anaerobic capacity of recreationally trained men, two familiarisation trials are recommended. A change in anaerobic capacity >4.4% is also required to exceed the CV of the MAOD test. The effect of multiple trials in determining variation of anaerobic energy contribution was unclear. In conclusion, two familiarisation trials for MAOD derived anaerobic capacity should permit reliability to exceed the criteria of CV <5% and ICC >0.80 (2).

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Contact
darezzolo@hotmail.com

A PILOT STUDY TO TEST RELIABILITY OF AN ACCOUSTIC-BASED JUDO-SPECIFIC BEEP TEST

KUGER, J.1,2, YANG, W.H.2, KIRBSCHUS, K.1, HEINE, O.2, VOGT, T.1

1: GERMAN SPORT UNIVERSITY COLOGNE (COLOGNE, GERMANY); 2: OLYMPIC TRAINING CENTRE RHINELAND (COLOGNE, GERMANY)

Introduction
In combat sport judo, athletes mostly use laboratory treadmill or judo specific all-out tests to determine their athletic performance. The aim of this study is to verify reliability of the judo-specific beep test (JBT).
Methods
Four male judo athletes as of national competing level (age: 20.5 ± 1.1 years, height: 173 ± 2.3cm, weight: 73.3 ± 5.8kg, body fat: 10.4 ± 1.3%) conducted the JBT twice, separated by 24 hours. The JBT contains an 8-meter shuttle run. On each side the athletes have to lie down in prone position. In the middle of the 8 meters they are asked to carry out a judo roll. Running speeds are predetermined via a standardized sound protocol, indicating a necessary increase in performance speed at every minute. The approximate all-out duration is 7 minutes. Respiratory standard parameters were measured with a portable ergospirometry testing system. The main focus was on absolute (abs.) and relative (rel.) maximum oxygen uptake (VO2max). Capillary blood samples were taken from each subject's earlobe at rest and in the first, second and third minute after each test. Subsequently, blood lactate (LACmax) was analyzed to determine metabolic states. Additionally, heart rate (HR) was recorded.
Results
During JBTs mean values of: rel. VO2max 49.18 ± 3.45ml•min-1•kg-1, ventilation (V'E) 150.60 ± 26.17l•min-1, respiratory exchange rate (RER) 1.20 ± 0.06, LACmax 10.10 ± 2.17mmol•l-1, breathing frequency (BF) 57.93 ± 6.27b•min-1, abs. VO2max 3597.90 ± 339.11ml, HR 189.88 ± 5.01b•min-1 were collected.
Following intra class correlation analysis (ICC) middle to high correlations were shown between two JBT measurements for rel. VO2max (ICC: r=0.654, p=0.257, CV=8.8%); abs. VO2max (ICC: r=0.830, p=0.145, 9.0%); V'E (ICC: r=0.942, p=0.021, CV=6.1%); LACmax (ICC: r=0.968, p=0.009, CV=7.2%); BF (ICC: r=0.767, p=0.131, CV=6.7%) and HR (ICC: r=0.933, p=0.026, 1.6%).
Discussion
Statistical analyses show middle to high correlations in VO2max and a high correlation in LACmax production between two JBTs and indicate reliability. Additional investigations analyzing more respiratory parameters (e.g. ventilation equivalent) and testing a greater number of athletes are necessary to further verify JBT reliability. Moreover comparing cardiopulmonary and metabolic parameters of a laboratory treadmill test with JBT may also test JBT's validity.

OPTIMAL LOCATING THE SPORT SPACES BASED ON IMPLEMENTING ANALYTIC HIERARCHY PROCESS ALGORITHM IN GEOGRAPHICAL INFORMATION SYSTEM

AHMADI, A., HONARI, H., SHAHLAEE, J., KARGAR, G.H.

ALLAMEH TABATABA1 UNIVERSITY

Introduction
Sport spaces are one of the most important facilities in the cities, because they have considerable role in increasing mental and physical health of citizens (Ahmadi et al., 2010). Today, the complexity of urban problems has led that various variables affect the locating of sport spaces (Ahmadi et al., 2010; Wicker et al., 2013). The analysis of these variables with traditional methods is not possible due to increased volume of data. So, using a powerful technique such as Analytic Hierarchy Process (AHP) and Geographical Information System (GIS) can help to locate effectively (Wong and Jusuf, 2008; Ahmadi, 2011).
Methods
The research method is Descriptive- analytic and is an applied one in terms of objective. For this, the opinions of 20 sport experts were used to identify the model and weighting the criteria introduced the locating of sport spaces.
Results
The results which collected in Expert Choice software shows that the weight of each criterion as follows: population density (0.487), development potential (0.272), accessibility (0.156), and proximity (0.0853).
Discussion
Using hierarchical analysis in GIS can be very efficient in locating sport spaces. With this method comparing different points according to the criteria for the purpose of establishing can be possible.
The results of this study also can be helpful in quantitative and qualitative development of sport places.
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RELATIONSHIP BETWEEN INTERMITTENT SUB-MAXIMAL FIELD-BASED TEST AND YO-YO IR1 IN RECREATIONAL SOCCER PLAYERS

PERRI, E., APONE, M., ALBERTI, G., IAIA, F.M.

UNIVERSITÀ DEGLI STUDI DI MILANO

Introduction

Monitoring physical performance is important to understand the fitness/fatigue status of the players throughout the course of the season (Mohr et al. 2003). However, due to the congestive game schedule, in contemporary elite football the time available for supramaximal/ exhaustive exercise assessments is often limited. Thus, the aim of the current study is to: i) evaluate the physiological response of an intermittent sub-maximal field-based test and its reliability; ii) examine its relationship with the Yo-Yo Intermittent Recovery1 (YYIR1) test, which assess a player's capacity to perform repeated intense exercise (Bangsbo et al. 2008).
Methods
Fifteen recreational male soccer players (age 17.4±0.5yr, height 175±7.5cm, body mass 67.1±6.5kg) were involved in the study. On two separated occasions, one week apart, the participants carried out a sub-maximal intermittent test and four days later the YYIR1 test. The sub-maximal test consisted of 15 50-m shuttle (2x25 m) runs at a constant speed of 15 km/h, interspersed by 8 s (5+5 m) of active recovery, controlled by audio signals. The total duration of the test was 5 min. Blood lactate was collected immediately after the test from an ear lobe (portable analyser Nova Biomedical, Lactate Plus) and the average heart rate (HR) was recorded throughout the test (Polar, RS400).
Results
Mean HR and blood lactate concentration ([La-]) were 168±5 bpm (84.2±2.9% of HRmax) and 4.96±1.6 mmol/l, respectively. No differences were observed in HR and blood ([La-]) between the test-retest (reliability 0.94 and 0.85 for HR and [La-], respectively). The distance covered in the YYIR1 was correlated to both HR mean ($r = -0.72$, $p<0.01$) and blood [La-] ($r = -0.69$, $p<0.01$).
Discussion
Mean HR and [La-] were of similar magnitude of the average values reported during a game indicating that the test taxes the aerobic mechanism to a large extent. The high test-retest reliability showed that such field-based test is reproducible and therefore appropriate for examining longitudinal changes in players' performance. The strong correlation observed with the YYIR1 also suggests that the intermittent sub-maximal test is a valid tool to obtain information about players' ability to perform repeated intense exercise.
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Contact
enrico.perri@unimi.it

VALIDITY/RELIABILITY OF A LOW-COST IMU-ENHANCED 50-HZ GPS RECEIVER FOR TEAM SPORT INVESTIGATIONS

PADULO, J.1,2, CULAR, D.2, IULIANO, E.3, DELLO IACONO, A.4, MILIĆ, M.2, ARDIGÒ, L.P.5

1:UNIVERSITY ECAMPUS (ITALY), 2:UNIVERSITY OF SPLIT (CROATIA), 3:UNIVERSITY OF MOLISE (ITALY), 4:ZINMAN COLLEGE (ISRAEL), 5:UNIVERSITY OF VERONA (ITALY)

Introduction
Global positioning system receivers (GPS) have spread out in the last decade as wearable devices commonly used in team sports to perform match analysis. Yet, over recent years coaches and scientists' focus moved from distances covered at specific speeds (S) to speed changes (i.e., accelerations/decelerations; Lyttle et al., 2000). To cope with the new need, GPSs had to further improve in terms of sampling frequency (SF) eventually by being supported by IMU components and frequently up to 15 Hz. Moreover some high-S game actions such as change of direction (COD) and dribbling occur within very short distances (<10m) exacerbating the need for higher SF to achieve adequate validity/reliability. Therefore the aim of this study was to assess validity/reliability of a new low-cost IMU-enhanced 50-Hz GPS over several differently-long actions featured by multiple CODs.
Methods
Six male young adults (27.4±0.9 yrs) were assessed in two different days while performing the following multiple-COD runs: 80m (20+20m×2 w/180° COD), 60m (15+15m×2 w/180° COD), 40m (10+10m×2 w/180° COD), 75m (7.5+7.5m×5 w/180° COD), 50m (5+5m×5 w/180° COD), 40m square (5+5+5+5m×2 w/90° COD), 60m zigzag (5+5+5m×2 w/90° and 180° COD), and 40m cross-path (10+5+5+10+5+5m w/90° and 180° COD). Runs were performed on a football pitch along paths measured with a professional measuring tape (1-mm sensitivity, Maurer, Italy). Each participant was equipped with an IMU-enhanced 50-Hz GPS (Spinitalia, Italy), while an operator timed each run with a manual 100-Hz chronograph (Delta E200, Hanhart, Germany) set to GPS time. Data were downloaded from GPS with the manufacturer's software (Bridge, Spinitalia, Italy) and processed with Microsoft Excel. Linear regression ($p<0.05$) and Bland Altman test were performed to check for the differences between Ss obtained by means of GPS vs. chronograph. Reliability was assessed by calculating Intra-class Correlations Coefficient (ICC).
Results
Linear regression analysis showed a strong relationship between the two methods for S measure ($R2=0.997$ $p<0.001$). Bland Altman test showed a 1.04% S error. Single- and average-measure based ICC resulted high ($ICC(2,1)=0.999$ and $ICC(2,5)=1.000$).
Discussion
Our study showed a new low-cost IMU-enhanced 50-Hz GPS provides valid/reliable S results on young adults performing several standardised differently-long actions within narrow spaces as well. Further research is expected to assess validity/reliability of this and/or similar devices during real game-play.
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Contact
sportcinetic@gmail.com

SPORTS BRACELET DATA BASED EXERCISE INTENSITY EVALUATION

ZHEN, Q., LIU, Y., LI, X.

CHINA INSTITUTE OF SPORT SCIENCE

Introduction
Walking, as a basic way of sports, directly reflects the behavior characteristics of the athletes. With the increasing awareness of fitness, walking is considered one of the best sports in the world. In this paper, the exercise intensity is divided into three different levels, i.e., lack of exercise, low level of exercise, and moderate level of sports. The aim of this study is to develop an approach to analysis the sports bracelet data and predict the exercise intensity automatically.

Methods
The walking steps, frequency, frequency histogram, local frequency histogram, local steps histogram are proposed to illustrate the exercise intensity, and Support Vector Machine (SVM) is adopted to train and classify the exercise intensity.
Results
Our database presently contains 1000 subjects, with a variety of age and BMI. We validate the proposed method and achieve 86.54% accuracy, and the state-of-the-art results demonstrate that our approach can be used to estimate the exercise intensity effectively.
Discussion
Walking steps is a key factor for measuring the amount of exercise, and frequency is an important indicator of exercise intensity. In order to make a comprehensively evaluation of the exercise, we should consider both the influence of exercise amount and intensity. The exercise features, i.e., walking steps, frequency, frequency histogram, local frequency histogram, local steps histogram, illustrate the exercise from different space. LibSVM classifier with different kernel are employed to train and predict the exercise intensity. It can be seen from the experimental results, the Chi-Square kernel achieves the best result.
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VALIDITY WRISTABLE ACTIVITY MONITORS FOR ASSESSING CARDIO METABOLIC DEMAND DURING TREADMILL WALKING/RUNNING IN YOUNG ADULTS

OKITA, Y., AYABE, M., HIGASHINO, Y., KUMAHARA, H.
OKAYAMA PREFECTURAL UNIVERSITY, NAKAMURA GAKUEN UNIVERSITY

Introduction
The wearable devices can be a useful tool for assessing the levels of the habitual physical activity, especially, the wristable devices has several advantages such as the easy to wear. However, in regard to the accuracy of these device, the results of the recent validation studies were not consistent. The purpose of the present investigation was to examine the validity of the wristable activity monitors for assessing cardio metabolic demand during the controlled condition.
Methods
The subjects of the present investigation were 21 healthy men and women (14 men, 7 females, 21 ± 2 years of age, 167.9 ± 8.0 cm of height, 58.8 ± 8.2 kg of body mass, and 20.8 ± 1.1 kg / m² of body mass index). All subjects performed a multistep exercise stress test using an electric treadmill, they walked at a speed of 60 m/min and a speed of 100 m/min and ran at a speed of 180 m/min for 5 minutes, respectively. During all course of the experiments, subjects wore 2 wristable activity monitor (A-360, POLAR, vivo smart HR J, GARMIN) on their wrist. Both wristable activity monitor estimated heart rate (HR) based on the blood flow sensing photo plesthysmography techniques, and the energy expenditure (EE). The chest band of portable HR monitor (Polar M 400, Polar) and the indirect calorimetry (AE-300S, Minato Medical Science) were used as the criterion measure for HR and EE, respectively. The HR was averaged over the final 30 seconds of each stage, and the total EE of each stage (5 minutes) was used for the data analysis. Finally, the eight of all subjects performed the second experiments under the same protocol and the measurement in order to assess the reliability of the wristable activity monitors.
Results
The HR obtained 2 wristable activity monitor was significantly correlated with the HR by the criterion measures ($p<0.05$). The relative measurement error in HR was ranged between -10.1 to 7.6%. The EE obtained 2 wristable activity monitor was significantly correlated with the HR by the criterion measures ($p<0.05$). The relative measurement error in HR was ranged between - 8.9 to 12.6 kcal / 5 min.
Discussion
The results of the present investigation indicated that the wristable activity monitor would provide a validate estimation for HR during treadmill walking/running in young adults. Additionally, some special caution may be required for the EE estimated by the wristable activity monitor. The validity wristable activity monitors for assessing cardio metabolic demand during intermittent activity including sporadic habitual physical activity remain unclear.

Mini-Orals

MO-PM04 Interval training 1

HIGH-INTESITY INTERVAL TRAINING EFFECTIVELY ENHANCES ADULT HIPPOCAMPAL NEUROGENESIS COMPARED TO ENDURANCE TRAINING IN RATS

OMURA, K., SHIMA, T., OHARAZAWA, A., SOYA, H.
UNIVERSITY OF TSUKUBA

Introduction
In modern society, where people have so little time, even health-promoting activities involving exercise for lifestyle-related diseases need to be cost-effective and sustainable. High-intensity interval training (HIIT) is a fitting regimen in that it more efficiently effects improvement of aerobic capacity and motivation than does endurance training (ET) (Burgomaster et al., 2008; Bartlett et al., 2011). Such benefits would be further enhanced if HIIT were clearly shown to also have an effect on cognitive function. Indeed, we recently found that a practical model of HIIT for four weeks enhances hippocampus-based learning and memory (2013 and 2015 ECSS) as well as VO2 peak and muscle growth in rats, which allowed us to postulate the involvement of adult hippocampal neurogenesis (AHN). Thus, here we aimed to clarify whether low volume HIIT effectively enhances AHN compared with ET.
Methods

Male Wistar rats (10 weeks old) were separated into three groups: HIIT (n=8), ET (n=6) and sedentary control (n=6), and animals in the HIIT and ET groups were both subjected to running training for four weeks with five sessions per week (HIIT: ten 30-sec bouts of exercise interspaced with 2.5 min of rest, ET: 30 min of continuous running at 20 m/min). In the HIIT group, running speed began to increase from 30m/min in the first week to 60m/min by the final week. The ratios of HIIT to ET were 1:6 for exercise time and 1:2~1:4 for exercise volume. After the training, the hippocampus was removed and sectioned coronally into 50-μm slices. The brain slices were co-stained for BrdU and NeuN to label adult-born mature neurons as AHN.
Results
Muscular enlargement of rat soleus and plantaris muscles was found only in the HIIT group, which is consistent with our previous findings and confirms the validity of the HIIT. We also found that only the HIIT group increased BrdU/NeuN positive cells compared to the control group, supporting our hypothesis that HIIT enhances AHN. We previously found that HIIT enhances spatial learning and memory compared to a control group.
Discussion
Thus, the current results, together with our previous findings, strongly suggest that a low volume HIIT could improve hippocampus-based learning and memory by promoting AHN. Our results differ from a report by Nokia (2016) showing that there is no effect of HIIT on AHN, but support evidence in humans (Drigny et al., 2014) that HIIT enhances cognitive functions.
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HIGH-INTENSITY INTERVAL ECCENTRIC CYCLING TRAINING IMPROVES MUSCLE FUNCTION AND AEROBIC CAPACITY

LIPSKI, M., ABBISS, C., NOSAKA, K.
EDITH COWAN UNIVERSITY

Introduction
Eccentric cycling training increases muscle strength and size (1), but its metabolic demand does not appear high enough to improve endurance capacity. High-intensity interval eccentric cycling training (HIT-EC), could increase the metabolic demand similar to concentric cycling (Gillen et al. 2014) and lead to greater improvements in both muscle function and aerobic capacity. The present study compared the effects of HIT-EC and high-intensity interval concentric cycling training (HIT-CC) for changes in peak oxygen consumption (VO2peak), maximal voluntary isometric contraction (MVC) strength of the knee extensors, squat (SJ) and countermovement jump (CMJ) height and peak power output during a 10 s sprint (PMAX) after 8 weeks of the training.
Methods
Eighteen men (19-56 y) performed either HIT-EC (n=10) or HIT-CC (n=8) twice a week for 8 weeks on an isokinetic cycling ergometer (Grucox Isokinetic Ergometer, South Africa). All training was performed in intervals, and the training intensity and volume were periodised. The HIT-EC group started at 45% and increased up to 70% of PMAX, while the HIT-CC group started at 30% and increased up to 36% of PMAX. Both were started with 5 x 2 min intervals with 1-min rest and progressively increased up to 7 x 2 min with 30-s rest between sets. CMJ, SJ, MVC and VO2peak were measured 3-5 days before the first training session and 1-3 days following the final training session. PMAX was measured 2-3 days before the first training session and 1-3 days after the last session. An independent t-test was performed to compare the changes in the parameters from pre- to post-training between groups. Effect sizes were also calculated via Cohen's d.
Results
VO2peak increased ($P<0.05$) after both HIT-EC and HIT-CC (2.0 ± 5.0% vs. 5.8 ± 6.0 %, d=-0.62), but the magnitude of the change was not different between groups (p=0.20). MVC also increased after HIT-EC and HIT-CC (8.8 ± 9.1% vs 5.7 ± 6.8%, d=0.39), but no significant difference between groups was evident (p=0.43). A greater improvement in SJ (p=0.0017, d=1.7) and CMJ (p=0.049, d=2.24) was observed following for HIT-EC (6.6 ± 3.7% and 3.9 ± 1.7%) compared with HIT-CC (-2.8 ± 4.7%, -4.3 ± 8.1%). PMAX also increased greater ($p<0.001$) after HIT-EC than HIT-CC (20.8 ± 5.9 % vs. 7.7 ± 5.9%, d=2.21).
Discussion
The results showed greater improvement of muscle function (CMJ, SJ, PMAX) following HIT-EC than HIT-CC, but increases in aerobic capacity were similar between HIT-EC and HIT-CC. The greater improvements in muscle function following HIT-EC than HIT-CC support the findings of the previous studies utilising a continuous cycling mode (Leong et al. 2014). The improvements in aerobic capacity following interval eccentric cycling indicate that this protocol can increase the metabolic demand and increase both strength and endurance.
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Contact
m.lipski@ecu.edu.au

HIGH INTENSITY INTERVAL TRAINING IS A SAFE, EFFICIENT AND EFFECTIVE FORM OF EXERCISE FOR TYPE 1 DIABETES PATIENTS

SCOTT, S.
LIVERPOOL JOHN MOORES UNIVERSITY

Introduction
Regular exercise improves fitness and reduces cardiovascular disease risk in people with type 1 diabetes (T1D). Clinical management recommends >150 min moderate intensity exercise per week. However, few patients achieve this, primarily due to a lack of time, fear of hypoglycaemia and inadequate knowledge around exercise management. High intensity interval training (HIT) is more time efficient than moderate intensity continuous training (MICT) and leads to similar improvements in VO2max and metabolic health in non-diabetic controls. Here we investigated the following hypotheses: that HIT 1) does not increase risk of hypoglycaemia, and 2) improves markers of health and fitness in people with T1D.
Methods

Thirteen sedentary people with T1D (6M/7F; age 24±2 yrs; BMI 27.7±1.4 kg·m-2) on a basal-bolus insulin regimen performed a bout of HIT (6x1min cycling at 100% VO2max, interspersed with 1min rest), MICT (30min continuous cycling at 65% VO2max) or no exercise (CON) in a randomised order with at least 48h separation, while interstitial glucose was measured using a continuous glucose monitor. Time in euglycaemia (5-9mM), hypoglycaemia (<5mM) and hyperglycaemia (>9mM), and number of hypoglycaemic episodes over each 24h period were measured. Five participants (3M/2F; age 26±2yr; BMI 29.1±1.5 kg·m-2) then completed 6 wks of HIT training (3x/wk of 6-10x 1min cycling at 100% VO2max, interspersed with 1min rest). Changes in VO2max, aortic pulse wave velocity (PWV) and 24h glucose profiles were measured from pre to post training.
Results
There was no difference in % time spent in hypoglycaemia between the 3 conditions over 24h (CON=14±3; HIT=15±5; MICT=13±4; P>0.05) or overnight (24:00-06:00; CON=20±6; HIT=17±5; MICT=14±4; P>0.05). Furthermore, the number of hypoglycaemic episodes over the 24h (CON=2.8±0.5; HIT=2.1±0.3; MICT=2.6±0.4; P>0.05) and overnight period (CON=0.5±0.1; HIT=0.5±0.2; MICT=0.7±0.3; P>0.05) was not different. Six wks of HIT improved aortic PWV (5.7±0.4 to 4.6±0.5 m/s; P<0.05) and VO2max (34.5±3.6 to 38.8±3.5 ml·kg·min-1; P<0.05). Following training there was a reduction in the % of time spent in hypoglycaemia in the CON day during the 24h period (16±5 vs. 13±5; P>0.05) and overnight (23±14 vs. 7±7; P=0.111), however this did not reach significance.
Discussion
An acute bout of HIT does not increase the post-exercise hypoglycaemia risk of people with T1D, and 6 wks HIT training is effective at improving aortic PWV and VO2max. As the latter is the most powerful predictor of longevity in the general population, we propose HIT as a safe and time-efficient alternative to MICT to increase cardiovascular health and longevity in T1D patients.

EFFECTS OF A SHORT TERM SPRINT INTERVAL TRAINING ON ENDURANCE CAPACITY AND NEUROMUSCULAR FATIGUE

BERTSCHINGER, R., GIBOIN, L.S., GRUBER, M.

UNIVERSITY OF KONSTANZ

Introduction
It has been shown that sprint interval training for a duration of only two weeks can increase endurance performance considerably (Burgomaster et al. 2005). It is not known if acute modifications of the central nervous system contribute to the observed performance increases. Therefore, in the present study we hypothesized to find neuromuscular adaptations in line with increases in endurance capacity after a short term sprint interval training.
Methods
19 healthy males (26±5 yrs.) were randomly assigned to a control (n=10) or a training (n=9) group, following either no training program or performing 32 Wingate Anaerobic Tests (WAnT) on a cycle ergometer in 6 separate sessions over a period of two weeks. Pre and post testing consisted of an incremental ramp cycling test and a constant load endurance cycling exercise to volitional exhaustion on two separate days. Power output in the endurance task was set at 67% of the maximum power reached during each ramp test. We determined central fatigue by means of maximal voluntary contraction (MVC), voluntary activation (VA) with transcranial magnetic stimulation of the motor cortex (VATMS), and supramaximal electrical peripheral nerve stimulation (VAPNS) before and after the endurance task. Peripheral fatigue was assessed by pre vs. post task potentiated resting twitches (QTW). A post hoc power analysis from the data of Burgomaster et al. (2005) was performed to calculate a minimum sample size of n=12. A mixed ANOVA was chosen to identify significant changes between groups for pre and post training as well as pre and post task measurements.
Results
No statistical difference in endurance performance (mean power, time to exhaustion, overall work), or any neuromuscular fatigue variable was found between both groups after the training regime. Fatigue recovery kinetics were not significantly different between groups. However, a time effect and further post hoc analyses revealed significant increases for VAPNS, QTW and MVC after the training period in both groups.
Discussion
The present study was designed to reveal possible underlying neuromuscular mechanisms of increases in endurance capacity that have been shown in a previous study by Burgomaster et al. (2005). However, despite an almost identical training intervention and subject group we were unable to replicate the performance increases in the present study. We were also not able to observe any differences at the neuromuscular level between groups. The present study highlights the importance of replicating other studies even if these studies apparently show very clear results.
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Contact
raphael.bertschinger@uni-konstanz.de

HIGH INTENSITY INTERVAL TRAINING ELICITS IMPROVEMENTS IN CARDIORESPIRATORY FITNESS WITHIN 31 DAYS IN UROLOGICAL BUT NOT COLORECTAL CANCER PATIENTS PRESENTING FOR SURGERY

BLACKWELL, J.E.M., BOEREBOOM, C.L., DAWSON, L.A., WILLIAMS, J.P., LUND, J.N., PHILLIPS, B.E.

UNIVERSITY OF NOTTINGHAM

Introduction
UK cancer guidelines impose a 31-day target time to operation from decision to treat (N.C.I.N. 2012). Therefore pre-surgical interventions need to be applicable within this time-frame. Poor cardiorespiratory fitness (CRF), particularly low anaerobic threshold (AT; <11ml/kg/min) is associated with increased perioperative mortality and morbidity (Older 2013). High-intensity interval training (HIIT) can improve CRF in healthy individuals within this 31-day window (Boereboom et al. 2016), and as such has potential to improve fitness for surgery.
Methods
Male colorectal (n=5) and urological (n=4) cancer patients scheduled for curative resection were recruited to the study and provided informed consent. Before and after HIIT cardio pulmonary exercise tests (CPET) and dual-energy x-ray absorptiometry (DXA) were used to assess CRF and body composition, respectively. All patients completed up to 12 supervised HIIT sessions within the 31 days prior to operation date. Each HIIT session consisted of 5x1min high-intensity cycling efforts interspersed with 90 seconds recovery.
Results

HIIT elicited significant improvements in the CRF of urological (AT: 13.73±2.26 vs 16.78±0.55 ml/kg/min, p=0.04; VO2peak: 25.68±3.61 vs. 29.23±4.43 ml/kg/min, p=0.03) but not colorectal cancer patients (AT: 14.68±2.42 vs 15.72±2.99 ml/kg/min, p=0.24; VO2peak: 23.52±4.02 vs. 25.12±3.02 ml/kg/min, p=0.27). There were no significant changes in lean body mass or percentage body fat in either group. Adherence to scheduled HIIT was 100% for both groups and no adverse events were reported throughout this study.
Discussion
These results show that it is feasible to deliver prehabilitation HIIT to cancer patients awaiting major curative surgery within a clinical time-frame. Despite urological and colorectal cancer patients (age matched: 72 years (IQR: 69.5-74.5)) completing the same HIIT protocol in each session, only the urological cancer patients demonstrated improved CRF. The preoperative clinical window facilitated 3 more sessions, on average, in the urological patients. This disparity in session number, or the higher systemic disease burden of colorectal cancer may explain these findings. More patients are required to fully elucidate the potential of HIIT as a preoperative strategy to improve CRF in different cancers.
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Contact
james.blackwell@nhs.net

THE EFFECT OF TWO WEEKS SPRINT INTERVAL TRAINING WITH SELF-REGULATED RECOVERY PERIODS ON PARAMETERS OF AEROBIC AND ANAEROBIC FITNESS

PHILLIPS, S.M.1, LEE, J.1, HOLROYD, J.1, GIBSON, N.2
1: UNIVERSITY OF EDINBURGH, 2: ORIAM; SCOTLAND'S SPORTS PERFORMANCE CENTRE

Introduction
Participants appear able to self-regulate recovery to maintain a consistent performance during sprint interval training (SIT). However, participants may over-estimate their required recovery time when self-regulating, which could reduce the physiological demand encountered during SIT. It is currently unknown whether self-regulated (SR) SIT would elicit the same training adaptations commonly seen during externally regulated (ER) SIT. This study investigated the effect of two weeks of SR SIT on markers of aerobic and anaerobic fitness.
Methods
Eleven recreationally active males (mean ± SD age 24.6 ± 3.4 years, height 179.0 ± 6.6 cm, body mass (BM) 82.3 ± 10.1 kg) were randomly assigned to an SR or ER training group. Both groups completed six sessions of SIT over two weeks, with each session comprising 10 x 6 sec cycle ergometer sprints against a resistance equal to 7.5% BM. The ER group were given 60 sec recovery between each sprint. The SR group were instructed to attempt to maintain their performance from sprint 1 across all 10 sprints, and to give themselves sufficient recovery between sprints to allow this performance maintenance. Before and after training, cycle ergometer peak power output (PPO), VO2max, ventilatory threshold (VT), and 250 kJ time trial (TT) performance were measured.
Results
Recovery duration was on average 91% longer in SR (114.7 sec) vs ER (60 sec). Peak heart rate (HR) across the six sessions was 149 ± 3 beat.min-1 and 157 ± 1 beat.min-1 in the SR and ER groups, respectively ($p < 0.001$). Cycle PPO significantly increased with training in both groups ($p = 0.001$; 14.5 ± 9.4% and 18.9 ± 14.0% in the ER and SR groups, respectively). Training significantly increased VO2max ($p = 0.022$) by 2.4 ± 6.5% in ER and 10.9 ± 6.2% in SR. Ventilatory threshold significantly ($p = 0.001$) increased with training by 16.9 ± 8.9% and 8.1 ± 4.7% in ER and SR, respectively. Time-trial performance was not significantly influenced by training or group. No significant training x group interactions were found.
Discussion
No significant between groups difference in power profiles despite a notably longer mean recovery duration in the SR group suggests that participants in that group may have overestimated required recovery duration, in line with previous research (Phillips et al., 2014). This is supported by the significantly lower peak HR in the SR vs. ER group. If overestimation of SR recovery duration occurred, it did not prevent aerobic and anaerobic adaptations comparable to those seen in the ER group. The lack of improvement in TT performance may be related to the short familiarisation trial, as learning effects can influence subsequent pacing strategies (Micklewright et al., 2010). This study suggests that SR SIT can elicit aerobic and anaerobic and aerobic performance adaptations comparable to ER SIT.
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Contact
shaun.phillips@ed.ac.uk

PHYSIOLOGICAL ADAPTATIONS OF AN 8-WEEK SUPRAMAXIMAL INTERMITTENT RUNNING TRAINING IN ELITE PROFESSIONAL SOCCER PLAYERS

GONÇALVES ORTIZ, J.
UNIVERSIDADE FEDERAL DE SANTA CATARINA

Introduction
Soccer is a sport that physical fitness could determine the technical efficiency and tactical organization during the match. The capacity of develop several high-intensity running during the competition is dependent of the high aerobic and anaerobic performance (Dupont et al., 2004). The supramaximal intermittent running training can be an important method for soccer players, mainly during the preseason to quickly improve physiological parameters. Thus, the purpose of the present study was to verify the physiological adaptations of an 8-week supramaximal intermittent training in elite professional soccer players.
Methods
Thirty soccer players were separated in two groups: intervention group (IG) and control group (CG). The IG performed two times per week training during eight weeks, consisted of supramaximal intermittent running with change of direction, at the intensity of 115% of maximal aerobic speed. In addition, maximal incremental running test to determine maximum oxygen uptake (VO2max), treadmill peak speed (TPS) and 20 meters fly speed test to determine the maximal sprinting speed (MSS) were performed before and after the intervention

period. Data were assessed by two-way analysis of variance (mixed model) ($p<0.05$). Effect size (ES) for each group was calculated, in which values of 0.2, 0.5 and >0.8 were considered small, moderate and large, respectively.
Results
After eight weeks of training VO2max changed from 55.0±5.4 to 58.4±4.5 ml·kg-1·min-1 in IG ($p<0.001$; ES:0.7); and from 54.5±3.8 to 55.1±4.4 ml·kg-1·min-1 in CG ($p=0.346$; ES:0.1); TPS increased from 15.9±1.1 to 17.4±1.4 km.h-1 in IG ($p<0.001$; ES:1.0); and 15.7±0.8 to 16.1±0.8 km.h-1 in CG ($p=0.064$; ES:0.5); In 20m fly no significant changes was observed from 29.9±1.1 to 29.9±1.0 in IG ($p=0.239$; ES:0.0) and 29.5±0.8 to 29.7±0.9 km.h-1 in CG ($p=0.995$; ES:0.2).
Discussion
The main novel finding of the present study is that supramaximal intermittent training at the 115% of maximal aerobic speed lead to an increase in physiological parameters such as VO2max and TPS when compared to control group, that performed only regular team training. However, the maximum sprinting speed did not change in both groups. These results are in agreement with previous studies that investigated both indices. Moreover, the improvement in TPS (8.6 and 1.2% in IG and CG, respectively) is in agreement with a similar study, in which improved 8.1% in soccer players (Dupont et al., 2004). Thus, supramaximal intermittent training conducted during soccer physical exercise is a key aspect for improvement of physiological indices.
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Mini-Orals

MO-PM05 Coaching and training: mixed session

THE ATHLETE-OPPONENT RELATIONSHIP ALTERS PACING DECISIONS AND INFORMATION-SEEKING BEHAVIOUR IN 4-KM CYCLING TIME TRIALS

KONINGS, M., FOULSHAM, T., MICKLEWRIGHT, D., HETTINGA, F.
UNIVERSITY OF ESSEX

Introduction
Pacing is widely recognized as an essential determinant for performance. However, the importance of in-race adaptations in response to what is happening around the exerciser has only been highlighted recently (Hettinga et al., 2017). This study examined how the interdependency between athlete and opponent, could affect exercise regulation. We hypothesized that a change in the interdependency between athlete and opponent evokes different pacing decisions and affects information-seeking behaviour.
Method
Twelve moderately trained participants completed five 4-km time trials (TT) on a VeloTron cycle ergometer. After two familiarisation TTs, participants performed in randomised, counterbalanced order a TT with no virtual avatar of an opponent projected on a screen (NO), a virtual opponent with no restrictions (low athlete-opponent interdependency; OP1), or a virtual opponent with the restriction that only 1 overtake would be allowed (high athlete-opponent interdependency; OP2). Information-seeking behaviour has been evaluated using a SMI Eye tracker. Differences in pacing, performance and information-seeking behaviour were examined using repeated-measures ANOVA ($p<0.05$).
Results
Neither mean power output (NO: 298±35W; OP1: 297±38W; OP2: 296±37W) nor finishing time (NO: 377.7±17.4s; OP1: 379.3±19.5s; OP2: 378.5±17.7s) differed between the experimental conditions. However, in OP2 participants adopted a slower initial pace in the first kilometre (NO: 332±59W; OP1: 325±62W; OP2: 316±58W; both $p<0.05$), and waited longer before they overtook their opponent (OP1: 137±130s; OP2: 255±107s; $p=0.040$). Moreover, total fixation time spent (NO: 7.4±5.9s; OP1: 38.6±36.2s; OP2: 37.4±19.2s; NOvsOP1: $p=0.013$, NOvsOP2: $p<0.001$) on focussing on the avatar of the participant itself increased when an opponent was present, while total fixation time spent on the avatar of the opponent increased when participants were only allowed to overtake once (OP1: 23.3±16.6s; OP2: 55.8±32.7s; $p=0.002$).
Discussion
A higher interdependency between athlete and opponent evoked a change in pacing behaviour in terms of in-race adaptations based on opponent's behaviour, and induces an increased attentional focus on the virtual opponent. Interdependency between athlete and opponent seems to be an important aspect affecting interpersonal relations in the race. This might explain the differences in pacing behaviour observed between different competitive sports and highlights the importance of athlete-environment interactions in the context of pacing.
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Contact
fjhett@essex.ac.uk

EFFECTS OF VOLUNTARY ABDOMINAL BRACING AND HOLLOWING MANEUVERS DURING SWIMMING ON IAP AND PERFORMANCE

MORIYAMA, S.1, KANAZAWA, S.2, KITAGAWA, Y.2, SHIBATA, Y.3, OGITA, F.4
1: TOKYO GAKUGEI UNIVERSITY (JAPAN), 2: JAPAN WOMEN'S COLLEGE OF PHYSICAL EDUCATION (JAPAN), 3: TEIKYO UNIVERSITY OF SCIENCE (JAPAN), 4: NATIONAL INSTITUTE OF FITNESS AND SPORTS (JAPAN)

Introduction
Intra-abdominal pressure (IAP) during swimming increases with swimming velocity because muscle activities involved in arm stroke and leg kicking are amplified (Moriyama et al., 2014b). This finding suggests that an increasing IAP to stabilize trunk is one factor for improving swimming performance. Also, it has been reported that abdominal co-contraction (bracing) and draw in the navel toward the spine (hollowing) on land increase IAP to stabilize trunk (Tayashiki et al., 2016; Vera-Garcia et al., 2007). Therefore, present study aimed to examine the effects of voluntary abdominal bracing and hollowing maneuvers during swimming on IAP and performance.
Methods

Nine highly trained competitive collegiate female swimmers performed 20m front crawl swimming with their maximal effort following three different conditions i.e., bracing (B), hollowing (H), and normal condition (N). Swimming velocity (V) as an index of swimming performance was calculated as dividing the distance by the time needed to cover between 12.5m and 20m. IAP was taken as the difference between minimum and maximum values using the mean of 2 stable front crawl stroke cycles.
Results
No significant differences were observed in V among conditions (B; 1.51 ± 0.07 m・s-1, H; 1.50 ± 0.07 m・s-1, N; 1.51 ± 0.06 m・s-1). Also, the same result was found in IAP (B; 3.0 ± 1.0 kPa, H; 2.7 ± 0.8 kPa, N; 2.3 ± 0.6 kPa).
Discussion
Although IAP increases by trunk muscles activation like as voluntary abdominal bracing and hollowing maneuvers on land (Tayashiki et al., 2016), it did not change during swimming. The result suggests that IAP during front crawl swimming is influenced more strongly by trunk muscles co-activation associated with moving their upper and lower limb (Moriyama et al., 2014a) than those of the voluntary abdominal bracing and hollowing maneuvers per se. Our findings demonstrate that neither IAP nor swimming performance would be influenced by the voluntary abdominal bracing and hollowing maneuvers during swimming.
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THE PROFILE OF HEART RATE TRAINING ZONES IN NON-ELITE ROWERS ACROSS A WINTER TRAINING PHASE

KEARNEY, R., MAHONY, N., DONNE, B., CLAFFEY, M., FLEMING, N., SHAKESPEARE, I., FALLON, A.
TRINITY COLLEGE DUBLIN

Introduction
The use of heart rate zones (HRZ) to add quality to training is now common practice in endurance athletes in the winter preparation phase of training. HRZ may be determined from interpolated heart rate (HR) blood lactate (BLa) relationships in laboratory based fitness tests. The aim of this study was to profile typical HRZ derived from laboratory based exercise testing in non-elite rowers throughout a winter training phase.
Methods
18 senior male rowers performed three incremental ergometer tests to volitional exhaustion in early (GXT1), middle (GXT2) and late (GXT 3) winter training phase. BLa and HR responses were plotted graphically, inputted into Excel format and using polynomial calculation, individual aerobic HRZ interpolated at BLa < 1 mmol/L (A1); 1 to 1.5 mmol/L (A2) and 2 to 3 mmol/L (A3) for the purposes of active recovery, aerobic conditioning, and lactate threshold training, respectively.
Results
Mean (±SD) HRZ in beats/min for GXT1 were; <146±18 (A1), 154±13 (A2), and 168±10 (A3); for GXT2 were; <158±11 (A1), 162±11 (A2), and 175±9 (A3); and for GXT3 were <153±11 (A1), 157±10 (A2), and 170±11 (A3). Statistical significant differences were noted in a number of HRZ ranges including; HRZ A1 from GXT1 vs. GXT2 as well as HRZ A2 and A3 between GXT1 vs. GXT2 and GXT2 vs. GXT3 (ANOVA; $P < 0.05$) with moderate effect sizes (Cohen's d). There was no statistical difference in HRZ A1 between GXT1 vs. GXT3 and GXT2 vs. GXT3 (ANOVA; $P > 0.05$).
Discussion
Aerobic metabolism supplies 75 to 80% of the energy demands for a 2000-m rowing race (Nilsen et al., 2002). Training should therefore emphasise aerobic intensities. HR monitoring is both a preferred mode of exercise intensity prescriptions (Achten et al., 2003) and a reliable measure of such intensities in endurance sports (Becque et al., 1993). Participant's HRZ prescriptions differed significantly across time points suggesting the need for serial modification of HRZ training prescriptions throughout a season.
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CORRELATION BETWEEN HRV AND A NEW TRAINING LOAD QUANTIFICATION MODEL

ROCAMORA, M.
UNIVERSIDAD MIGUEL HERNÁDEZ

Introduction
Quantification models aim to analyze the response to training, adaptive control process and make effective the training and recovery, especially in sports with high training volumes, such as road cycling. Furthermore, heart rate variability (HRV) is a validated method for assessing the response of the autonomic nervous system (ANS) quickly, reliably and noninvasively. This tool enables new possibilities to control the training load. The aim of this study was to explore the relationship between of a new whole body bioenergetics TRIMP based on the triparametric model (Hayes & Quinn's TRIMP) and HRV.
Methods
After three weeks of familiarization with procedures and performed test to determining VO2max, critical power (CP), anaerobic work capacity (AWC) and Maximal Power Output (Pmax), 12 well-trained road cyclist performed 8 weeks of homogenous individual training (Figure 1) to record their individual training data (duration, heart rate, power output and rate of perceived effort (RPE)) and HRV daily records.
Results
Hayes & Quinn's TRIMP presents moderate correlation with HRV in: SDNN ($r = -0.61$; $p < 0.05$) and LF ($r = 0.64$; $p < 0.05$).
Discussion
According with these findings, training load calculated thought Hayes & Quinn´s TRIMP reflects a relationship with HRV. Thus, this model is a promising mathematical model based on an individual bioenergetics' profile that could be used to quantify training load in road

cycling. This research extends our knowledge about training load models that use power output to measure intensity. However, further research is required to establish the possibilities of this model.

PASSING PERFORMANCE IN RELATION TO TRAINING LOAD AMONG YOUNG TALENTED SOCCER PLAYERS

PORTELA, J., KRUG, J., CLAUSS, M., HARTMANN, U.

UNIVERSITY LEIPZIG - FACULTY OF SPORT SCIENCE

Introduction
Passing performance (PP) is a good descriptor for performance differences between strong and weak teams (Liu et al., 2016). Soccer specific exercises may have detrimental effects on short-PP depending on the fitness level of the players (Rampinini et al., 2008). Surprisingly, only a few articles address this problem (Russell et al., 2011). The study aims to investigate the development of the short-PP in the training process and possible effects of training loads (TL) on that.
Methods
Five players (15.9±0.2 yrs; 65.7±11.2 kg; 174.7±8.0 cm; VO2max 4.1±0.5 l/min) belonging to a young elite team volunteered to participate in the study. Players performed a pass test (3 times à 15 passes) using 4 reactive rebound passing grids (Smartspeed, Fusion Sport, AUS) according to Krause et al. (2012), following each training session (TS) during a period of 15 training weeks. PP was analysed regarding time of everyone pass. Based on individual heart rate zones (Castagna et al., 2011) TS were categorized by means of a median split into low (LL) or medium to high load (MHL). PP of LL and MHL were compared using the paired student t-test.
Results
PP was measured 42 - 48 TS for each player; the overall mean was 1.92±0.66 s. The PP frequently varied during the training process (variation coefficient 0.34). In four players, no significant difference of the PP was found between LL and MHL (t(713 to 797)=-.910 to .119, p=.363 to .997), but different in one player (t(755)=-3.094, p=.002).
Discussion
By considering the used categorization of TL it appears that PP is not strongly (effect size, d< 0.16) influenced by the current TL. In spite of unfavourable fatiguing exercise effects on peripheral muscle function, elite players show compensatory mechanisms in order to maintain the PP (Rampinini et al., 2011). The data of this study supports this notion even in training process. Other factors like external climatic conditions or training contents may affect the PP more substantially.
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Contact
spo09jrx@studserv.uni-leipzig.de

Mini-Orals

MO-PM08 Thermoregulation and respiration

PHYSIOLOGICAL MODIFICATIONS INDUCED BY ACUTE AIRBORNE PARTICLE EXPOSURE DURING HIGH INTENSITY EXERCISE.

BRACAGLIA, E., FUSCO, A., CORTIS, C., RODIO A.

UNIVERSITÀ DEGLI STUDI DI CASSINO E DEL LAZIO MERIDIONALE

Introduction
In industrialized countries most common physical activities usually occurs in urban microenvironments with high levels of airborne particles (PM10) concentrations. Exercising in polluted urban areas increases particles inhaled amount as a result of the increased minute ventilation (Carlisle and Sharp, 2001). Since there is a lack of studies investigating acute physiological effects of high PM10 levels, this study aimed to assess physiological parameters during incremental maximal aerobic tests on a cycloergometer under low and high PM10 exposures.
Methods
Following informed consent, 9 male amateur cyclists performed 2 tests for each environmental condition: low and high PM10 concentration. Exposure scenarios were replicated using a fully controlled environmental chamber. Peak oxygen consumption (VO2peak), carbon dioxide production (VCO2peak), respiratory frequency (RFpeak), tidal volume (VTpeak), pulmonary ventilation (VEpeak), hearth rate (HRpeak) and mechanical power output (Ppeak) values were recorded for each trial. Gross efficiency (GE) was determined using the ratio between mechanical power output and metabolic power input. T-test was applied to evaluate differences ($p<0.05$) between physiological parameters.
Results
According to trial protocol, all subjects achieved equal mechanical power (Ppeak) in the 4 incremental tests. No significant differences in HRpeak, RFpeak and VEpeak were found. VTpeak increased ($p<0.05$) under high exposure (39.69 ± 8.12 ml•kg-1) compared to low exposure (38.16 ± 6.75 ml•kg-1). Differences ($p<0.05$) for VO2peak were found between low (38.39 ± 4.05 ml•kg-1•min-1) and high particles concentration conditions (41.68 ± 4.31 ml•kg-1•min-1). Since same mechanical work was expressed while significant VO2peak differences were recorded, GE reduced ($p<0.02$) during sustained exercise under high PM10 concentrations (21.47 ± 1.74 %) compared to low (23.24 ± 1.35 %) with a mean difference of 1.77%.
Discussion
The present findings indicate that during high intensity exercise GE is affected by high PM10 concentrations. As GE is defined one of the most important functional abilities of cyclists (Coyle, 1995), results suggest that cyclist's athletic performances are impaired by polluted microenvironments.

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EFFECT OF 8-WEEK INSPIRATORY MUSCLE TRAINING ON ELITE MALE RUNNERS

CHIANG, C.H., CHUNG, C.C., CHEN, C., SU, J.H., WU, S.K.

NATIONAL TAIWAN UNIVERSITY OF SPORT

Introduction
Recently, the focus on the respiratory muscle training has been emphasized. The purpose of this study was to examine the effect of 8-week inspiratory muscle training (IMT) on elite male runners.
Methods
Twenty elite male runners (12 distance runners, 8 sprinters) ages 18 to 26 years received IMT for eight weeks. The IMT program included 30 times of resistant inspiration each section, 2 sections every day, and 6 days every week for 8 consecutive weeks. Data were collected by lung spirometry, blood pressure instrument, 20-meter shuttle run, 400-m run, and 5000-m run (distance runners only) before and after the 8-week IMT period. Basic data and cardiopulmonary data including tidal volume (TV), forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1.0), maximal ventilation volume (MVV), maximal inspiratory pressure (MIP), resting heart rate, blood pressure, predicted maximal oxygen consumption (VO2max), and 400-m were analyzed with two-way ANOVA mixed design to compare two running groups between pre- and post-training. The 5000-m in the distance runners were analyzed with paired t-test.
Results
The VT, FVC, FEV1, MVV, and MIP significantly increased after training ($p<0.05$) in both groups. Sprinters had higher FVC, FEV1, MVV, and MIP than distance runners ($p<0.01$). The interaction effect of group and training in VO2max was significant ($p<0.01$), and the VO2max of distance runners was higher than sprinters ($p<0.01$). Furthermore, sprinters had higher VO2max after training ($p<0.01$). The sport performance of 400-m did not show a significant change in both groups, but the 5000-m performance of distance runners improved after training ($p<0.05$).
Discussion
The findings revealed that there was a positive effect of 8-week IMT for sprinters and distance runners on several indexes of lung functions and the 5000-m performance of distance runners improved. These findings were similar to the previous study (HajGhanbari et al, 2013).
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Contact
Ching-Hsiu Chiang, e-mail: j00362@hotmail.com

TIME-OF-DAY EFFECT OF SOLAR RADIATION ON THERMOREGULATION DURING OUTDOOR EXERCISE IN THE HEAT

OTANI, H.1, GOTO, T.2, SHIRATO, M.3

1: HIMEJI DOKKYO UNIVERSITY (HIMEJI, JAPAN), 2: NATIONAL INSTITUTE OF TECHNOLOGY, AKASHI COLLEGE (AKASHI, JAPAN), 3: NIPPON SPORT SCIENCE UNIVERSITY (TOKYO, JAPAN)

Introduction
Increasing solar radiation during exercise in a hot environment has been shown to reduce thermoregulatory capacity and endurance performance (Otani et al. 2016). However, it is unknown that the effects of variations in radiation from the sun accompanied by diurnal change in the angle of sunlight on body temperature in individuals exercising outdoors in the heat. The aim of the present study was therefore to investigate the time-of-day effect of changing solar radiation associated with solar elevation angle on thermoregulatory responses during outdoor exercise in the heat under a clear sky.
Methods
Eight male volunteers, high school baseball players, completed 3 hours of outdoor baseball practice in mid-August. They commenced exercise at 0900 h in the AM trial and at 1600 h in the PM trial each on a separate day. Core (infrared tympanic) temperature, skin temperature (chest, upper arm, thigh and calf), heart rate and perceived thermal sensation and exertion were recorded at rest and at 60 min intervals during exercise.
Results
Solar radiation and solar elevation angle during exercise continued to increase in the AM trial (672-1107 W/m2; 44-69°) and decrease in the PM trial (717-0 W/m2; 34-0°), and were higher on the AM trial than on the PM trial (both $P < 0.0001$). There were no differences in ambient temperature (AM 33.9 ± 1.3°C, PM 33.0 ± 2.4°C; $P = 0.442$), relative humidity ($P = 0.072$), wind speed ($P = 0.820$) and wet-bulb globe temperature (AM 32.0 ± 0.7°C, PM 30.0 ± 2.3°C; $P = 0.074$) between trials. Core temperature and mean skin temperature were higher on the AM trial than on the PM trial at 120 and 180 min of exercise ($P < 0.05$). Heart rate at 120 min of exercise was higher in the AM trial than the PM trial ($P < 0.05$). Perceived thermal sensation ($P = 0.320$) and rating of perceived exertion ($P = 0.523$) were not different between trials.
Discussion
The present study demonstrates that core temperature, skin temperature and heart rate are higher on the AM trial than on the PM trial. These responses are associated with an increase in solar radiation and solar elevation angle during exercise, suggesting that thermoregulatory and cardiovascular strain are greater in AM compared with PM in individuals exercising outdoors in the heat. Moreover, there are no differences between trials in perceived thermal sensation and exertion, indicating no difference in the perception of hotness and fatigue between them irrespective of body temperature and heart rate.
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Contact
hotani@himeji-du.ac.jp

EFFECTIVENESS OF HAND COOLING ON POST-EXERCISE COOLING RATE IN HYPERTHERMIC ATHLETES

MARONI, T., WALLMAN, K., DAWSON, B., BARNETT, K., GUELFI, K., NAYLOR, L., BRADE, C.
UNIVERSITY OF WESTERN AUSTRALIA

Introduction
Hand cooling represents a practical cooling method for reducing core temperature following strenuous exercise in the heat. However, no studies have quantified the use of the cooling glove in an athletic population or in comparison to other common cooling modalities used in team sports. Therefore, the aim of this study was to assess the effectiveness of hand cooling (applied to one or two hands) using a cooling glove (~16°C water temperature; sub-atmospheric pressure of -40 mmHg) on post exercise cooling rates (core temperature, Tc; skin temperature, Tsk) and choice reaction time (CRT) in comparison to trunk cooling using an ice jacket, or no cooling, following strenuous exercise in hot/humid environmental conditions.
Methods
Twelve non-heat acclimatised male team-sport athletes performed four trials using a within subjects, counterbalanced design. Trials involved cycling at a workload equivalent to 75% VO2max in hot conditions (35.7 ± 0.2°C, 49.2 ± 2.6% RH) until a Tc of 39°C was reached or exhaustion occurred. This was followed by a 30 min post-exercise cooling period in the laboratory (22.3 ± 0.3°C, 42.1 ± 3.6% RH) where participants either adopted one hand cooling (1H), two hand cooling (2H), wore an ice jacket (IJ), or no cooling (NC).
Results
No significant differences were seen in Tc cooling rates during 30 min of cooling between trials (1H=0.044°C/min, 2H=0.041°C/min, IJ=0.047°C/min, NC=0.042°C/min), however moderate ES (d=0.50-0.76) suggested a tendency for Tc cooling rates to be faster for 1H and IJ compared to NC after 10 min of cooling and for IJ to be faster than 2H at 25-30 min of cooling (d=0.55-0.60). No significant differences were found for mean Tsk cooling between trials however the IJ trial resulted in a significant main effect for thermal sensation, where participants overall felt cooler compared to all other trials. Stroop test CRT was significantly faster following exercise ($p<0.001$) and post cooling ($p<0.05$) compared to baseline for all trials.
Discussion
Overall, post-exercise cooling with the glove (one hand) and the ice jacket resulted in faster cooling rates than the control condition in the first 10 min of cooling, with no additional benefit associated with applying the glove to both hands. If only short periods of time were available during a field event to cool athletes then it would be feasible to employ either method (over passive cooling), with the glove representing a less cumbersome modality to use. Further, while there was no effect of the cooling glove(s) or ice jacket on cognitive performance during recovery, CRT was faster following exercise and post cooling in all trials compared to baseline, highlighting the effect of exercise and a higher Tc on mental performance.

RELATION BETWEEN THERMOREGULATION AND VO2MAX IN MALE ENDURANCE ATHLETES

GALÁN , J., SUÁREZ, A., GUERRA-BALIC, M.
FACULTY OF PSYCHOLOGY, SCIENCE EDUCATION AND SPORT OF BLANQUERNA

Introduction
The ability of thermoregulation is essential for adapting to exercise demands. A good adaptation is needed to maintain an adequate performance in endurance sports (ES) and prevent fatigue. The aim of this study was to analyze the relationship between aerobic power (VO2peak) and the thermoregulatory variability of skin temperature (Ts) in trained male adults of endurance sports during a progressive treadmill test, and study if a better thermoregulatory variability could determine a better functional capacity.
Methods
Twenty-three trained male adults of ES (age=38,5 (7,8) years; height= 177, 9 (6, 2cm)) with the same activity level, participated in the study after signing an informed consent. Each participant performed a progressive increasing treadmill test until exhaustion in a room with a stable humidity of 40-60% and a temperature of 24 °C. During the test, cardio-vascular and ventilation responses were monitored with a gas analyzer (Powercube-Ergo, Ganshorn Medizine Electronic) and skin temperature (Biopac Student Lab), it was also obtained the Borg's RPE scale. The protocol of the maximal test consisted of 6 minutes of warming up at 6km/h, followed by a graded exercise test in a treadmill with an increasing speed of 0,5km per minute, until exhaustion. The treadmill slope was constant at 1,5%. All values (VO2, VCO2 RER, VE, HR, RPE, Ts) were monitored at rest, during exercise and during 10 min of the recovery period. Data analysis included descriptives and One- Way ANOVA.
Results
VO2peak was 48,5 (5,3). All values significantly increased from basal until peak point. All variables decreased after their peak values during recovery period, except the Ts was 35,7 (1,1) and RER was 1,1 (0,1), which were higher after 5'. ANOVA showed a mayor Ts variability ($p= .044$) correlated with VO2peak ($p= .024$) values.
Discussion
Results showed that there was a better aerobic power on subjects that had a better thermoregulatory variability of skin temperature during the test and in the recovery period. A higher thermoregulatory variability during treadmill test could determine the VO2peak and indicate a better autonomic nervous system response to endurance exercise. More research is required to determine how the thermoregulatory component could provide a better VO2peak.

Mini-Orals

MO-PM19 Ageing and neurofunction

EFFECTS OF DIFFERENT EXERCISE MODES ON NEUROPROTECTIVE GROWTH FACTORS AND NEUROCOGNITIVE PERFORMANCE IN OLDER ADULTS WITH MILD COGNITIVE IMPAIRMENT

CHUANG, C.Y., TSAI, C.L., PAN, C.Y., GAN, Y.C., PAI, M.C., UKROPEC, J., UKROPCOVÁ, B.
NATIONAL CHENG KUNG UNIVERSITY

Introduction

Reduced circulating levels of the neuroprotective growth factors (e.g., BDNF and IGF-1) and the presence of an early executive functioning deficit in persons with the preclinical Alzheimer's disease stage (e.g., mild cognitive impairment, MCI) have been demonstrated in a growing body of research (Howe, 2014; Laske et al., 2007; Murialdo et al., 2001). However, no research has yet been conducted on whether exercise could effectively induce the secretion of these neuroprotective growth factors and facilitate neurocognitive performances in the older adults with MCI. The present study was thus aimed to investigate the effects of acute aerobic and resistance exercise on changes in neurocognitive performance and biochemical markers when performing a cognitive task in older adults with MCI.
Methods
Sixty older adults with MCI were recruited and randomly assigned to an aerobic exercise (AE) group, resistance exercise (RE) group, or non-exercise-intervention group. The neurocognitive indices (e.g., reaction time (RT), accuracy rate, and event-related potential P3 amplitude) were simultaneously measured when the participants performed a Flanker task at baseline and after either an acute bout of 30 minutes of moderate-intensity AE, RE or a control period. Blood samples were taken before and after exercise intervention.
Results
The acute AE and RE could not only benefit RTs performance, but also enlarge the P3 amplitudes in the older adults with MCI. The post-exercise BDNF and IGF-1 levels were significantly higher than the pre-exercise ones for the AE group. Only the IGF-1 levels were significantly increased in the RE group. However, the changes in the levels of BDNF and IGF-1 were not correlated with the changes in RTs and P3 amplitudes.
Discussions
The older adults with MCI could change the levels of neuroprotective growth factors and see better neurocognitive performances through acute AE or RE, suggesting that the individuals at this stage of the disease still exhibit brain neuroplasticity and the ability for biochemical enhancement. Although both AE and RE modes could significantly improve neurocognitive performance in the older adults with MCI in this study, it seems that, compared to RE, AE could be more effective for increasing the levels of neuroprotective growth factors in this neurodegenerative disease.
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EFFECTS OF OPEN- AND CLOSED-SKILL EXERCISE INTERVENTIONS ON EXECUTIVE FUNCTIONS IN OLDER ADULTS

GAN, Y.C., TSAI, C.L., PAN, C.Y., CHUANG, C.Y.
NATIONAL CHENG KUNG UNIVERSITY

Introduction
To date, there is a lack of longitudinal research on the impact of long-term open- and closed-skill exercise interventions on various forms of executive function in older adults. The present study thus aimed to clarify the distinctive effects of long-term open- and closed-skill exercise training on the neurocognitive performance of older adults when performing different cognitive tasks.
Methods
Sixty healthy elderly males were recruited and randomly assigned to either an open-skill (OS, n=20), closed-skill (CS, n=20), or control (n=20) group. Various neurocognitive measures (e.g., reaction times (RTs), accuracy rates (ARs), and event-related potential P3 amplitude) were assessed during the task-switching paradigm and an N-back task at baseline and after either an exercise intervention or control period. The participants in OS and CS groups were regularly trained in a series of 40-minute sessions conducted three times per week for 24 weeks.
Results
In terms of the task-switching paradigm, the OS and CS groups relative to the control group showed significantly faster RTs in the switch trials after the exercise intervention. However, only the OS group exhibited RTs facilitation in the switch trials post- relative to pre-exercise. With regard to the N-back task, the ARs were significantly increased in the 1-back condition after the exercise in the OS and CS groups. However, the beneficial AR effect on the 2-back condition only emerged in the CS group. Additionally, the OS and CS groups exhibited significantly larger P3 amplitudes across all conditions and electrodes post-exercise relative to pre-exercise when performing the two cognitive tasks. These results remained unchanged even when the confounding factors (e.g., VO2max and BMI) were controlled for.
Discussion
Although long-term open- and closed-skill exercise interventions facilitate overall neurophysiological effects (i.e., P3 amplitudes) in the elderly when performing not only the task-switching paradigm, but also the N-back task, the two exercise modes produced different levels of neuropsychologically beneficial effects on RTs and ARs when performing the two cognitive tasks. Since different physical exercises could affect the brain in different ways (Burrel, 2015; Voelcker-Rehage et al., 2011), further MRI/fMRI studies to explore the changes in the sizes/densities of the brain tissues are helpful to understand the complex relationship between different exercise modes and neurocognitive performances.
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Contact
Tsai, Chia-Liang: andytsai@mail.ncku.edu.tw

SMART: INTERACTIONS BETWEEN PAIN, THE BRAIN, AND THE PEAK OXYGEN UPTAKE IN ELDERLY PERSONS: RESULTS FROM A RCT

FLECKENSTEIN, J.1, NEWRLY, J.1, MATURA, S.2, PILATUS, U.3, ENGEROFF, T.1, FÜZEKI, E.1, VOGT, L.1, PANTEL, J.2, BANZER, W.1
GOETHE-UNIVERSITY FRANKFURT AM MAIN, GERMANY

Introduction
Hippocampal volume has been associated with the severity of cognitive decline and dementia. Whereas cardiorespiratory fitness has been proposed to enhance, pain is supposed to negatively influence our cognitive performance. The relation between all three variables is sparely investigated. We hypothesise pain to affect activity, this leading to a cognitive decline.
Methods

We report baseline data resulting from the SMART trial (https://clinicaltrials.gov/show/NCT02343029), a RCT to explore the exercise induced neuroprotective and metabolic effects on the brain in cognitively healthy older adults (n = 53, age > 65). Quantitative MRI of the brain was performed via T1 mapping based on the variable flip angle method. The whole brain analysis was followed by a Region of Interest (ROI) analysis with the hippocampus as ROI. Volumes of bilateral hippocampi were read out for each subject. The history of pain was assessed by means of the German Pain Questionnaire. The peak oxygen uptake (VO2peak) was obtained from cardiopulmonary exercise testing. The statistical analysis between the subjects with no pain and those with at least moderate pain (i.e. a pain intensity above 3 cm on a 10 cm visual analogue scale VAS) included the pairwise comparison of pain intensity, VO2peak, and hippocampal volume. Further analysis included bivariate correlations and a mediator analysis.
Results
The overall pain intensity ranged from 0 to 8.5 cm VAS. The mean intensity in the group perceiving pain according to the WHO definition (n = 10) was 6.4 ± 1.6 cm VAS ($p < 0.001$ to no pain). There was a trend towards decreased hippocampal volume in the pain group $p = 0.094$). The VO2peak was significantly reduced (16.4 ± 2.7 vs. 23.7±5.9 ml/kg, $p < 0.001$). There was no difference in total intracranial volume. There was a strong correlation between VO2peak and VAS ($r = -0.432$, $p < 0.001$), and VO2peak and hippocampal volume ($r = 0.504$, $p < 0.001$), and a trend between VAS and hippocampal volume ($r = -0.232$, $p = 0.095$). Further analysis revealed the effects of pain on the hippocampal volume to be indirectly mediated via the VO2peak (β = -57.7, 95% CI 114.1; 20.0).
Discussion
This report shows for the first time that the effects of pain on the brain are likely mediated via the level of cardiorespiratory fitness. Thus, the influence of pain on the brain is indirect and could be the expression of a reduced pattern of physical activity. Further research should focus on the role of pain as a limiting factor of physical activity.

TWO SUPERVISED EXERCISE PROGRAMS AND THEIR EFFECTS ON COGNITIVE AND PHYSICAL STATE OF OLDER PERSONS WITH MILD COGNITIVE IMPAIRMENT

BAAKE, R.1, ABELN, V.1, RUEDIGER, S.1, STUCKENSCHNEIDER, T.1,2, SCHNEIDER, S.1,2

1: GERMAN SPORT UNIVERSITY, GERMANY (COLOGNE); 2: UNIVERSITY OF THE SUNSHINE COAST, AUSTRALIA (MAROOCHYDORE)

Introduction
Previous studies could examine the positive effects of physical activity on cognitive and physical capacity of persons with Alzheimer's disease. During the last years research focused on the preliminary stage of Alzheimer's disease, the Mild Cognitive Impairment (MCI), which seemed to be a promising treatment approach for intervention programs. Although intervention programs with MCI patients already showed a positive effect on the progression of the disease, more studies about the effects on cognition and physical status are needed. For deeper insights this study examines and compares the effects of two supervised physical programs (aerobic exercise (AER) and stretching & toning (S&T) on the cognitive (executive functions) and physical status of older persons with MCI.
Methods
A total of n=67 persons with MCI [M=73.2 ± 5.5 years, 36 male, 31 female] were divided into the two intervention groups (AER: n=23; S&T: n=26) and an inactive control (CG: n=18). The AER and S&T-group attended at least two sport classes a week over six months. The physical and cognitive tests, which were completed at baseline and after six months, included the maximum handgrip strength, the 30-Second Chair Stand Test, an incremental cycle ergometry stage test including lactate diagnostics and the Trail Making Test B (TMT-B).
Results
No significant changes were found for the maximum handgrip strength and the 30-Second Chair Stand Test. The performance time at the TMT-B significantly changed for the S&T-group only, which showed a deterioration (p=.037). The AER-group tend to increased their endurance capacity, their results of the TMT-B (p=.129) and the cycle ergometry (p=.183). There were no significant changes within the CG. Additionally, highly significant correlation between the results of the cycle ergometry and the TMT-B (p=-.347; p=-.346) was found for all groups.
Discussion
The S&T-program of this study led to a deterioration of executive functions. Future sport programs for MCI patients should prefer aerobic exercise instead to maintain the cognitive functions due to the found correlation between aerobic capacity and cognition. Eventually further intervention studies could examine other cognitive domains apart from the executive functions and increase the period of intervention to more than six months.
Contact
Ricarda Baake, ricarda.baake@live.de

RELATIONSHIP BETWEEN SEDENTARY BEHAVIOUR AND COGNITIVE PERFORMANCE

CARTER, S.E., DRAIJER, R., THIJSSEN, D.H.J., HOPKINS, N.D.

LIVERPOOL JOHN MOORES UNIVERSITY

Introduction
Sedentary behaviour (SB) has emerged as a cardiometabolic health risk factor, independent of physical activity (PA) levels. However, minimal research has investigated if SB influences measures of cognitive performance. PA is known to enhance cognitive function, but whether SB also influences cognitive performance is unknown. The workplace has been identified as a key setting where adults accrue SB, however the relationship between workplace SB and cognitive performance is currently unknown. Firstly, to assess if there is a relationship between daily SB and cognitive performance. Secondly, to assess whether workplace SB is associated with cognitive performance. It was hypothesised that greater time spent in daily and workplace SB would be associated with lower cognitive performance.
Methods
Thirty-two healthy participants (14 male, 30.2±10.3 years old, BMI: 24.1±3.3 kg/m2) wore two activity monitors, activPAL and SenseWear Pro 3, for seven days to monitor SB and PA respectively. On each workday, participants recorded the time that they started and finished work. Following the monitoring period, participants completed a battery of cognitive function tests to measure executive function (Stroop Colour-Word Test), attention (Attention Network Test) and working memory (N-Back Task). Partial correlation analysis was used to assess the relationship between daily SB and all cognitive variables with covariate control for daily moderate PA levels; and the relationship between workplace SB and all cognitive variables with covariate control for daily moderate PA levels. Data is presented as mean±SE.
Results

Per day, total SB was 57.4±2.7% of waking hours. Workplace SB was 61.3±2.7% of self-reported working hours. There was a significant correlation between total daily SB and reaction time for the N-Back Task at the hardest level of memory recall (r=-0.35, p=0.05). Neither total daily nor workplace SB were significantly correlated with any other cognitive performance measures (p>0.05).
Discussion
In our cohort of healthy workers, SB does not appear to be associated with most cognitive performance measures. However, caution should be taken when interpreting these findings due to the small sample size included in the study. In addition the population assessed were predominantly sedentary during working hours, meaning those who are active at work are underrepresented. Consequently, further research is needed to determine the relationship between SB and cognitive function.

THE USE OF REAL AND IMAGINED TIMED UP AND GO TASKS IN ASSESSING COGNITIVE IMPAIRED OLDER PERSONS

RUEDIGER, S.1, STUCKENSCHNEIDER, T.1,3, VOGT, T.2, ABEL, V.1, SCHNEIDER, S.1,3
1& 2: GERMAN SPORT UNIVERSITY COLOGNE; 3: UNIVERSITY OF THE SUNSHINE COAST AUSTRALIA

Introduction
To enable early interventions and treatment for patients suffering from dementia, recent research focuses on prodromal stages as subjective (SCI) or mild cognitive impairment (MCI). Recent approaches suggest the use of an imaginary version of the Timed up and Go (TUG) test for assessing cognitively impaired older persons. The objective of this study was to examine whether cognitive impairment has an effect on gait performance and whether this is reflected in differences of a real (TUGr) and an imagined (TUGi) TUG task performance.
Methods
A total of 52 persons (23 females; 29 males) between the age of 60 – 75 years (mean age: 69.3 ± 4.0 years) with MCI or SCI were included in this study. The participants were divided into three groups according to their achieved score in the Montreal Cognitive Assessment Battery (MoCA) (Group 1: MoCA > 25; Group 2: MoCA 23 – 25; Group 3: MoCA 19 – 22). The time difference in the performance between the real and the imagined TUG task was used as main outcome, whereas the MoCA was the main independent variable.
Results
The difference between the TUGr and the TUGi performance times increased with decreasing cognitive function and significant differences could be shown between the groups ($p < .01$). Moreover, there was a significant correlation between the TUG time difference and MoCA score ($r = -.489$, $p < .01$).
Discussion
The combination of TUGr and TUGi may be used as quick assessment method for detecting ongoing cognitive changes older persons. Furthermore differences between the real and imaginary task may have added value in cognitive function assessment of MCI and SCI patients.
Contact
Steffi.Ruediger@gmx.net

MOTIVATION AND PHYSICAL AND MENTAL HEALTH STATE IN "OVER FIFTIES" NON-SEDENTARY PEOPLE

IONA, T.1, SEGURA-GARCIA, C.2, AMMENDOLIA, A.1
UNIVERSITY OF CATANZARO

Introduction
Epidemiological studies have revealed that physical activity can reduce risks for obesity as well as preventing several chronic diseases , to improve both physical and mental health state and even reducing mortality (Svantesson et al., 2015; Prakash et al., 2015). Since life expectancy has been prolonged, it is important that both mental and physical health be maintained in adulthood and the elderly (Aaltonen et al., 2014). If we are to understand why some subjects do regular physical activity in leisure time, then we need to clarify which factors underlie individual differences in physical activity behavior. It is known that many different factors play a role in leisure-time physical activity behavior (Koeneman et al., 2011). Motivations to do physical activity are very different across people, especially over 50 years of age. Our aim at assessing the association between motivations of adult people to do physical activity and their physical and mental perceived health status.
Methods
Overall 118 participants (44 men; 74 women), 61,08±8,78 years old, BMI=26.85±6.65 kg/m2) answered the SF-36 and a physical assessment target questionnaire.
Results
Most participants do physical activity to "stay healthy" (31%) or by "custom" (40%); less frequent motivations are fun (4%), socialization (9%) and body image (17%). According to the results of Linear Regression Analysis, independent predictors of Physical perceived health status (PCI: R2=36,8; F=8,619; p<,001) resulted to be younger age, lower BMI and aerobic exercise. Conversely, older age, lower BMI and aerobic exercise resulted to be independent predictors of the mental perceived health status (MCI: R2=13,3; F=3,008; p=,003). No significant association was between specific motivations either with PCI or MCI. Fun is the only motivation that seems to positively influence the value of MCI, but the significance is lost after controlling for BMI and age.
Discussion
The physical and mental perceived health status of people over 50 years old do not seem to be influenced by the motivation to do physical activity. Instead aerobic exercise seems to improve both indicators.
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Contact
iona@unicz.it

THE EFFECTS OF BDNF EXPRESSION BY EXERCISE ON HIPPOCAMPUS AND SKELETAL MUSCLE OF AGING RAT

AHN, N., KIM, K., KIM, C., LIM, C.
KEIMYUNG UNIVERSITY

Introduction
Exercise is important in promoting neuroplasticity by growing and developing of nerve cells. Exercise can stimulate the myokines secretion of skeletal muscle and induce activation of the brain growth factor. It has been reported that BDNF is expressed (Wrann et al., 2013) by increasing FNDC5 regulation after endurance exercise treatment of white rats. However, the pathway of BDNF expression in brain and skeletal muscle is not clear. The aim of this study was to identify the effects of BDNF expression by several exercise on FNDC5 and PGC-1α that are associated with hippocampus and skeletal muscle adaptive response.
Methods
50 week old male Wistar rats were randomly assigned to four group: the sedentary (Con, n=10), resistance training (RT, ladder-climbing exercise, n=10), aerobic training (AT, treadmill exercise, n=10) and dynamic exercise group (AT+RT, n=10). Exercise training program included of ladder-climbing exercise and treadmill exercise, 3 days per week, for 12 weeks.
Results
The aerobic exercise group of the BDNF and PGC-1α protein levels significantly ($p<0.05$) increased than control group in tibialis anterior muscle. Also, IL-4 (AT, RT and AT+RT group) and BDNF (AT, RT and AT+RT group) were significantly ($p<0.05$) increased in brain hippocampus. Especially, brain hippocampus BDNF and PGC-1α protein was significantly ($p <0.05$) correlated with IL-4 in tibialis anterior muscle.
Discussion
Therefore, dynamic resistance exercise in aged rats was increased myokines in skeletal muscle and hippocampus. We had the anti-inflammatory cytokine IL-4 protein expression in skeletal muscle and BDNF expression in hippocampus can be seen that the correlation.
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Contact
nyahn13@kmu.ac.kr

Mini-Orals

MO-PM28 Rehabilitation of back and shoulder

EFFECTS OF A REHABILITATION PROGRAM USING PILATES EXERCISES ON LOW BACK PAIN IN ATHLETES

MOBARK, A.1,2, MAHMOUD, M.2, HELMY, H.2, ELMAHALAWI, M.3, NAGATOMI, R.1
TOHOKU UNIVERSITY, GRADUATE SCHOOL OF BIOMEDICAL ENGINEERING

Introduction
Low back pain (LBP) is a major health problem that affects both ordinary individuals and athletes. Abdominal muscle weakness is one of the central causes of LBP. Pilates exercise is considered to be one of the most commonly used methods for improving LBP. This is significant because there are nearly no previous studies that were focused on the effect of Pilates exercises on LBP in athletes. The purpose of this study was to identify the effects of a rehabilitation program using Pilates exercises on LBP of athletes by improving spine mobility and increasing abdominal muscle strength.
Methods
The study was approved by the Ethics Committee of Tanta University. Eight male athletes with LBP without leg pain for less than 6 weeks participated in this study (age = 24.7 ± 2.18 years). The study was conducted between August 2015 and March 2016 (12 weeks), with thirty-six individual sessions. Lumbar flexibility was evaluated by Modified Schober Test. Abdominal and lower back strength were evaluated by posterior trunk flexion and extension using the Biodex isokinetic dynamometer at the angular velocity of 60°/s (F60, E60), and 180°/s (F180, E180). Pain intensity was evaluated using a visual analog scale.
Results
The Pilates intervention resulted in an increased level of lumbar flexibility. We also found significant improvement in strength at F60 and E60. Similarly, an increase was observed in strength at F180 and E180. The ratio between the back and abdominal muscle at the angular velocity 60 deg/s and 180 deg/s decreased from pre-test to post-test. There was a significant decrease in the pain intensity (all $p< 0.05$).
Discussion
Although there are no studies that demonstrate the effect of Pilates exercises in the rehabilitation of LBP for athletes, many studies confirmed its effectiveness in the treatment of LBP in different populations (Yamato et al., 2015). Our study results showed the improved flexibility of the trunk region, increased strength of the abdominal and back muscles, and improved symmetry between abdominal and lower back muscle strength. As a result of the aforementioned increase in spine stability, our participants experienced a reduction in LBP (Klizienе et al., 2016; Wells et al., 2014). Randomized controlled study is necessary to confirm the results.
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EFFECT OF 4 WEEKS GLUTEUS MEDIUS STRENGTHENING EXERCISE ON BACK MUSCLE STRENGTH AND BODY BALANCE IN FEMALE 20'S WITH CHRONIC LOW BACK PAIN

PIL HA, H., JEONGMOO, R.1, SUK HO, L., GI DUCK, P.1, CHARYONG, K.1
KYUNGPOOK NATIONAL UNIVERSITY

Introduction
The purpose of the study was to investigate the effect of 4 weeks gluteus medius strengthening exercise on back strength and body balance in female 20's with a chronic low back pain.

Methods
A total of thirty female college students who have a chronic back pain were randomly assigned to exercise (N=15) and control (N=15) groups. After back strength and body balance measurement, the participants were asked to do sixty-minute workout three times a week for four weeks. After restudying of Kristen's (2011) study about the glutes strengthening exercises, Pill-Ho Jang (2014) designed a workout program with the 5 most effective glutes strengthening workout that includes the 5 minutes of warm-up, 50 minutes of the workout of glutes strengthening, and 5 minutes of cool down. You should be exercising 3 times per week with this program. By using SPSS 18.0 program, the average and the standard deviation obtained from each group were put into a chart, and two-way ANOVA by repeated measure was conducted to verify differences between two groups and the measuring points. In addition, to analyze the interaction effects, paired sample t test and independent sample t test were conducted in each group with significance level 0.5.
Results
For the function of lumbar muscle, flexor value and %BW of peak torques there were no significant differences in both groups (p>.05), also both extensors Value and %BW were increased in an exercise group (each p<.001, p<.001), but not in a control group (each p>.05, p>.05). On the body balance, performance was increased in an exercise group (p<.001), but not in a control group (p>.05).
Discussion
According to the results of the study, the participants showed positive results on body balance, but flexor value and %BW of peak torques in the function of lumbar muscle could not make significant effectiveness. In short, gluteus medius strengthening exercise affected on pelvic stabilization, however, it was not applied to trunk stability. Therefore, doing both gluteus medius strengthening exercise and trunk stability exercise would deliver the most effective result to patients with chronic lumbar pain.

EFFECTS OF SCHROTH EXERCISE ON IDIOPATHIC SCOLIOSIS IN PATIENTS WITH 4-CURVE DOUBLE TYPE: CASE REPORT

LEE, S.Y.1, KIM, A.R.1,2, LEE, S.A.1, LEE, H.S.1

1: DANKOOK UNIVERSITY (KOREA, SOUTH), 2: NAMSEOUL UNIVERSITY (KOREA, SOUTH)

Introduction
Adolescent idiopathic scoliosis (AIS) is a three-dimensional deformity of the spine which is usually not symptomatic and which can progress during growth and cause a surface deformity (Bettany-Saltikov et al., 2016). According to the Lehnert-Schroth (2000), AIS is classified into seven types of curvature. Among the seven curve patterns, 4-curve double (4C) type is a major lumbar curvature with a compensatory thoracic curvature and a pelvis that shifts and rotates to the opposite side of the lumbar curvature. The purpose of this case study was to investigate the effects of the Schroth exercise on Cobb's angle, thoracic and lumbar angle of trunk rotation (ATR), internal and external hip joint rotation in AIS patients with 4C.
Methods
The subjects included 15-year-old female patients (n = 3) who had diagnosed with AIS according to radiographic findings in Cobb's angle of more 10 degrees and 4C type. They performed the Schroth exercise for 140 minutes per day and 3 times per week, for 12 weeks. Cobb's angle, ATR of thoracic and lumbar spine and internal and external hip joint rotation range of motion (ROM) were measured before and after 12 weeks of 4C Schroth exercise program.
Results
Cobb's angles of thoracic and lumbar spine were decreased in all cases after the Schroth exercise compared with before exercise. ATR of thoracic and lumbar spine were decreased in the 2 cases after Schroth exercise compared with before exercise. Internal and external hip joint rotation ROM were improved in all cases after the Schroth exercise compared with before exercise.
Disscussion
Cobb's angle and Internal and external hip joint rotation ROM may be improved by enhancement of spine and hip joint attaching muscles via repeated movements of muscle cylinder and side lying muscle cylinder. In this study, one case was not changed ATR of the thoracic spine. So, we speculated that this case had larger Cobb's angle (over 50 degrees) than other 2 cases, thus needed to long-term exercise for improving the ATR of the thoracic spine. This study suggest that Schroth exercise improves Cobb's angle and Internal and external hip joint rotation ROM in patients with 4C.
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Contact
hoseh28@dankook.ac.kr

THE EFFECT OF A CORRECTIVE FUNCTIONAL EXERCISE PROGRAM ON POSTURAL THORACIC KYPHOSIS IN TEENAGERS: A RANDOMIZED CONTROLLED TRIAL

FENG, Q., MEI, W., YU, Z., YANFENG, Z.

CHINA INSITITUTE OF SPORT SCIENCE

Introduction
It was the aim of the study to investigate the effects of a corrective functional exercise program on postural thoracic kyphosis in teenagers in China.
Methods
Design: A double-blind randomized controlled trial including students with a thoracic kyphosis angle>40 degrees measured using the SpinalMouse.
Setting: China Institute of Sport Science and three middle schools in Beijing, China.
Subjects: 181 subjects were included in this trial; of these, 164 subjects were included in the analyses (intervention group, n=81; control group, n=83).
Intervention: All study subjects received two 20 minutes exercise sessions each week for 8 weeks during their physical education classes at high school.
Main measures: The primary outcome variable was thoracic kyphosis angle (TKA). Secondary outcome variables were lumbar lordosis angle (LLA), sacral angle (SA), and incline angle (INA) measured in the upright position; thoracic, lumbar, and sacral spine range of motion (ROM) and incline angle ROM (change in center of gravity) measured in the forward bending and extended positions; and changes in TKA, LLA, SA, and INA measured during the Matthiass test.

Results
There were significant differences in pre- and post-test thoracic kyphosis angle in both groups (intervention group: pretest 47.09±5.45, post-test 38.31±9.18, p<0.0001; control group: pretest 47.47±6.06, post-test 43.59±7.49, p<0.0001). After adjustment for gender and pretest values, there were significant differences in post-test thoracic kyphosis angle, change in SA, and thoracic ROM in the intervention group compared to the control group (p<0.05).
Conclusion
The corrective functional exercise program designed for this study improved exaggerated thoracic kyphosis in teenagers.

COMPARISON THE EFFECT OF AQUATIC EXERCISE AND KINESIO TAPING ON PAIN AND DISABILITY IN SUBJECTS WITH NON-SPECIFIC CHRONIC LOW BACK PAIN

ALIKHAJEH, Y.1, FAZELI, K.2, FAZELI, H.2, HOSSEINI, S.2, FAZELI, S.2, BARABADI, F.A.E.3
YOUNG RESEARCHERS AND ELITE CLUB, MASHHAD BRANCH, ISLAMIC AZAD UNIVERSITY, MASHH

Introduction
Chronic low back pain (CLBP) is a growing problem in many communities, but there is no consensus regarding the most appropriate therapeutic intervention. The purpose of this study was to compare the effect of aquatic exercise and kinesio taping on intensity of pain and functional disability in female subjects with non-specific chronic low back pain.
Methods
Thirty six females with non-specific chronic LBP (mean age ± SD; 50.69 ± 4.187 years) were purposefully selected and assigned into three groups of twelve persons. For the first group, aquatic exercises were carried out and the second group were taped with Kinesio Tape while the control group received no training. The treatment lasted six weeks. Visual Analogue Scale (VAS) for the assessment of pain (Jensen et al., 2003) and Oswestry Questionnaires Scale for functional disability assessment were used (Fritz & Irrgang, 2001). For data analysis repeated measure ANOVA & LSD and pair sample T test were applied at the significance level of p<0.05.
Results
Pain intensity was reduced significantly in both groups after intervention (P<0.001). Moreover, comparing data after intervention showed prominent difference in functional disability between two groups (P<0.001).
Discussion
The significant role of muscles and soft tissues around the spinal cord in causing back pain has been acknowledged by many researchers. They argue that the weakness of the muscles to support inactive structures against extra weight might ruin these structures which are sensitive to pain, and ultimately cause pain in these persons. Aquatic exercise and kinesio taping decrease the back pain in females. The patients with non-specific chronic low back pain can do these exercises to reduce their pain because these exercises are both inexpensive and without any risk.
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Contact
yaser_alikhajeh@yahoo.com

ENERGY EXPENDITURE DURING FUNCTIONAL ELECTRICAL STIMULATION LEG CYCLING IN PEOPLE WITH SPINAL CORD INJURY: EFFECT OF ADDITIONAL MUSCLE RECRUITMENT

JANSSEN, T.W.J.1,2, ATSMA, T.1,2, MOEDIG, B.2, VAN DER ZWAN, S.2, SMIT, C.A.J.2
1: VRIJE UNIVERSITEIT AMSTERDAM, FACULTY OF BEHAVIOURAL AND MOVEMENT SCIENCES (THE NETHERLANDS), 2: AMSTERDAM REHABILITATION RESEARCH CENTER | READE (THE NETHERLANDS)

Introduction
For a part of the spinal cord injury (SCI) population, the only way to regain or maintain physical fitness is through functional electrical stimulation (FES) exercise. However, FES exercise does not always induce sufficiently high exercise responses, possibly due to a small activated muscle mass. The goal of this study, therefore, was to evaluate the cardiorespiratory and metabolic effects of the addition of shank, abdominal and arm muscle stimulation to conventional FES cycling.
Methods
Eight adults (1 female; 42±8 yrs) with subacute/chronic SCI (C3-T7, ASIA A-B) performed supine 30-min FES cycling (RT300 Supine, Restorative Therapies) with four stimulation protocols (passive, 6-channel (conventional; FES-6), 12-channel (+ shank/abdominal stimulation; FES-12) and 16-channel stimulation (12-channel + arm stimulation; FES-16) on four days. Exercise intensity was determined by measuring oxygen uptake (VO2), heart rate (HR), rating of perceived exertion (RPE), and blood lactate (BL) levels. Energy expenditure (EE) was determined with VO2 and carbon dioxide production (VCO2).
Results
FES cycling significantly (p<0.01) increased all cardiorespiratory and metabolic parameter values relative to rest and passive cycling. The increase of VO2 and EE were significantly higher with FES-12 compared to FES-6 (+19%) and FES-16 compared to FES-6 (+20%) but the addition of arm stimulation by itself (16 vs 12-channel) did not significantly increase any measured parameter value. HR, RPE, and BL were significantly (p<0.01) higher with FES-6, FES-12 and FES-16 compared to rest or passive cycling, while responses in FES-12 and FES-16 only tended to be higher than in FES-6.
Discussion
The addition of shank and abdominal muscle activation effectively increases cardiorespiratory exercise intensity and energy expenditure, while HR, RPE and BL tended to be higher with the additional muscle stimulation. Additional muscle recruitment during FES exercise may, therefore, be useful to increase exercise intensity and energy expenditure during FES exercise.
Contact
t.janssen@reade.nl

MUSCLE ACTIVATION DURING COMMON REHABILITATION EXERCISES FOR SHOULDER IMPINGEMENT SYNDROME: A KINETIC CHAIN APPROACH

MCMAHON, J., ALIZADEHKHAIYAT, O.

LIVERPOOL HOPE UNIVERSITY

Introduction

Shoulder Impingement Syndrome is caused by strength deficits and imbalances within the Scapulothoracic muscles (Ellenbecker & Cools, 2010). These imbalances are more prevalent in athletes that use excess amounts of shoulder abduction, external rotation and extension during overhead actions (McClure et al., 2000). It is widely known that these movements involve not only the use of the upper limb muscles but also other kinetically linked muscles throughout the body (McMullen & Uhl, 2000; De Mey et al., 2013). However, the commonly prescribed rehabilitation exercises for impingement syndrome rarely consider the activation of these other segments throughout the kinetic chain sequencing. The purpose of the study was to investigate EMG activity of the shoulder girdle muscles along with key trunk/core and lower extremity muscles during eight commonly shoulder rehabilitation exercises.

Methods

Twelve physically active volunteers participated in this study (6 male, 6 female; Age: 21.3 ± 1.2 years). Surface EMG was used to compare activation of ten muscles involved in the kinetic chain sequencing of overhead actions: Upper trapezius (UT); Middle trapezius (MT); Lower trapezius (LT); Serratus Anterior (SA); Multifidus (MF); External oblique's (EO); Left and right Gluteus Medius (LGMED/RGMED); Left and Right Rectus Femoris (LRF/RRF) during eight rehabilitation exercises (Scaption (SCAP); Abduction (ABD); Knee push up (PU); Prone row (ROW); Quadruped arm and lower extremity (Bird dog - BD); External rotation @ 0° with underarm towel (ER@0); External rotation @ 90° abduction (ER@90); Internal rotation @ 90° abduction(IR@90)).

Results

Seven of the ten muscles were significantly activated during all exercise conditions (P<.05 to P<.001). Six of the exercises optimally activated MT, LT and SA with minimum activation of UT, the greatest differences seen in the ROW and PU conditions (23-44% difference). Greatest activation for all but three of the muscles was seen in the BD exercise including upper extremity, lower extremity, trunk and core muscles (10.36%-69.71).

Discussion

The study provides an insight to the current activation levels of the muscles involved in overhead sports. The BD exercise elicited greatest activity in majority of the muscles in question, including exercises such as this open chain multi segment movement but also with diagonal movement patterns will be beneficial at targeting strength deficits not only in the scapulothoracic muscles but also in other segments involved. Additionally, the use of the PU and ROW exercises with their low UT/MT, LT and SA activation ratios will be advantageous in targeting the imbalances during rehabilitation.

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SHOULDER AND ELBOW INJURY PREDICTION IN OVERHEAD ATHLETES WITH SCAPULAR DYSKINESIS TEST AND KERLEN-JOBE ORTHOPEDIC CLINIC SCORES

TSURUIKE, M.1, ELLENBECKER, T.S.2, HIROSE, N.3, KAGAYA T.4

1: SAN JOSÉ STATE UNIVERSITY, CALIFORNIA, USA, 2: PHYSIOTHERAPY ASSOCIATES SCOTTSDALE SPORTS CLINIC, ARIZONA USA. 3: WASEDA UNIVERSITY, JAPAN, 4: SHOWA UNIVERSITY, JAPAN

Introduction

Scapular dyskinesis (SD) has been recently intensively investigated for the purposes of diagnosis and rehabilitation of the symptomatic shoulder. Also, the questionnaire for the status and function of the shoulder and elbow for overhead athletes has been established as the Kerlan-Jobe Orthopedic Clinical (KJOC) score. No previous research has yet to identify the relationship between SD and KJOC score in baseball pitchers. The purpose of study was to identify SD along with KJOC scores from the preseason to immediately after postseason.

Methods

Thirteen National College Athletic Association (NCAA) Division-I college baseball pitchers were tested. The KJOC instrument was conducted in preseason and immediately after the season in 2016. Also, the SD test was conducted in shoulder flexion and extension with a 7lb wrist cuff for 5 seconds constantly following a metronome in the standing position. After recoding was completed in all 13 subjects, the videotape was copied and distributed to one physical therapist and one certified athletic trainer to identify the scapular classification type. A two-way mixed measures ANOVA was used to identify differences in KJOC scores between pre- and post-season for the pitchers with and without SD.

Results

All of the 13 pitchers reported their status categorized as "playing without any arm trouble" in the preseason. However, 6 pitchers were identified as Type I SD and one pitcher as Type II SD in the preseason. All of the SDs were mild. Those with SD had significant decreases in the KJOC scores from preseason to postseason (89.3 ± 12.0, 60.5 ± 21.8 respectively, P < .01), whereas the remaining 6 pitchers without SD did not significantly change the KJOC scores between pre- and postseason (84.2 ± 13.8, 76.3 ± 23.8 respectively). Furthermore, 3 pitchers with SD reported their status categorized as "playing with arm trouble" and 1 pitcher with SD reported his status categorized as "not playing due to arm trouble" in the postseason. Also, 4 starting pitchers who were categorized showed a score of 90.5 of KJOC in the postseason, whereas 8 relief pitchers showed a KJOC score of 57.4.

Discussion

A critical and significant relationship between the SD test and KJOC score existed, which may contribute to injury prediction for young baseball pitchers. The KJOC scores decreased in both starters and relievers from the pre- to post-season.

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Contact

masaaki.tsuruike@sjsu.edu

Mini-Orals

MO-PM12 Coaching: Tennis and golf

SERVICE GAME DEVELOPMENTS IN MENS WORLD CLASS TENNIS AT WIMBLEDON FROM 2002 TO 2015

GRAMBOW, R., MEFFERT, D., O'SHANNESSY, C., BORN, P., VOGT, T.
GERMAN SPORTS UNIVERSITY

Introduction
The development in modern Tennis underlines the importance of the serve, return and the opening shots. Thus, the importance of good serving in men's world class Tennis seems to be crucial to succeed, particularly on faster surface such as lawn; however, a chronological development of the service game has to be elucidated. Therefore, the present study aimed to systematically analyse the development of serving behavior in men's Tennis.
Methods
Historical data (IBM®), collected from all matches at the men's Wimbledon Championship between 2002 and 2015 (total matches n=1772) served for analyses. Serve winning percentages (total serves n=401527), aces (total aces n=38173) and double faults (total double faults n=14420) as well as success-rates of service games (total service games n=63838) and serve-and-volley strategies (i.e. played, won) were computed over first compared to second tournament weeks, serving as well-accepted indicators to distinguish success at world class level.
Results
From 2002 to 2015, first (interaction $p<0.05$) but not second serves (interaction $p>0.05$) supported winning the point more often in the second (first serve e.g. 2002 70.15 ± 4.96% and 2015 75.86 ± 1.66%; second serve e.g. 2002 47.45 ± 6.22% and 2015 53.91 ± 2.37%) compared to the first week of the tournament (first serve e.g. 2002 73.47 ± 0.22% and 2015 75.00 ± 0.46%; second serve e.g. 2002 49.39 ± 0.25% and 2015 52.88 ± 1.13%), whereas an increase in aces and a decrease in double faults (interaction $p<0.05$) were consistent in the first (aces e.g. 2002 8.65 ± 0.46% and 2015 10.88 ± 1.31%; double faults e.g. 2002 5.18 ± 0.34% and 2015 3.71 ± 0.52%) compared to the second week of the tournament (aces e.g. 2002 6.37 ± 1.65% and 2015 10.37 ± 2.10%; double faults e.g. 2002 4.12 ± 1.13% and 2015 2.33 ± 0.99%). Additionally, in both the first (played e.g. 2002 35.50 ± 7.40% and 2015 11.51 ± 2.68%; won e.g. 2002 67.10 ± 0.43% and 2015 70.33 ± 1,81%) and the second week of the tournament (played e.g. 2002 22.27 ± 18.38% and 2015 9.18 ± 2.88%; won e.g. 2002 65.72 ± 5.35% and 2015 70.42 ± 2.46%), the serve-and-volley strategy was decreasingly used from 2002 to 2015, whereas winning-percentages having played serve-and-volley remained consistent (interaction $p<0.05$)
Discussion
With particular impact on the second week of the tournament, the present findings indicate the development of increased serve efficiency in men's world class lawn Tennis from 2002 to 2015.

WHAT TO PRACTICE? APPROACHING SERVE-BEHAVIOURAL IMPACT FACING BREAK POINTS IN WORLD-CLASS MEN'S TENNIS AT WIMBLEDON 2016

MEFFERT, D., GRAMBOW, R., O'SHANNESSY, C., BORN, P., VOGT, T.
GERMAN SPORTS UNIVERSITY

Introduction
The serve is well accepted being one of the most dominant strokes in world-class Men's Tennis. With this, the serving behaviour in pressuring match situation (i.e. facing break points) is considered to have major impacts on the outcome of a match, which, however, remains to be elucidated in modern Men's Tennis. Thus, the presented study used serve-beneficial surface data (i.e. lawn) to analyse the serving behaviour facing break points (BP) compared to regular serve points played (RP).
Methods
Official IBM data generated at the 2016 Men´s Wimbledon Championship was conduced for analyses, comprising a total of 28843 serve points played (BP: n=2035; RP: n=26808). Repeated measures ANOVA were computed for first serve-in percentages (1st-in) with factors points played (BP, RP) and group (match-winners W, match-losers L) as well as for first (1st-won) and second serve-won percentages (2nd-won) with factors points played, group and serve (1st, 2nd).
Results
For 1st-in there was no significant interaction between factors group and points played ($p=0.21$); however, main effects for group revealed an increase ($p<0.01$) in W (BP 64.32 ± 22.88%, RP 64.75 ± 6.71%) compared to L (BP 59.33 ± 15.83, RP 62.68 ± 6.56%), whereas played points were not modulated by 1st-in ($p=0.18$). No interaction was shown for 1st-won and 2nd-won with factors serve, points played and group ($p=0.18$); however, regardless of W and L, factors serve and points played interacted significantly ($p<0.05$) for 1st-won and 2nd-won. Post-hoc test revealed decreased BP compared to RP after 1st serves ($p<0.01$; BP: W 72.80 ± 29.59%, L 59.58 ± 68.09%; RP: W 78.88 ± 7.36, L 68.09 ± 8.04%) but not after 2nd serves ($p=0.73$; BP: W 67.02 ± 46.80%, L 50.13 ± 30.70%; RP: W 61.22 ± 10.39%, L 54.52 ± 11.37).
Discussion
The present findings underline a well-accepted impact of serve behaviour on the outcome of a match. Additionally and as a first step, it may be suggested that practice patterns taking specific match situation such as the ones considered to be pressuring (i.e. facing break points) into account, require careful coaching to not only improve serve-in but also serve-winning percentages – in particular on the 1st serve behaviour.

SERVICE CHARACTERISTICS IN ELITE JUNIOR TENNIS PLAYERS OF DIFFERENT SEX AND AGE GROUPS

GATZKE, D., FETT, J., ULBRICHT, A., VUONG, J., OBERSCHELP, N., FERRAUTI, A.
RUHR-UNIVERSITÄT BOCHUM

Introduction
The tennis serve has been described as the most potentially dominant shot in modern tennis game, as well as the most important from a strategic standpoint. Nonetheless, it is a highly complex stroke because of the reliance on multiple segments in the kinetic chain to produce optimal power that facilitates summation, regulation and the transfer of the applied forces from the lower body to the racket (Kovacs

and Ellenbecker, 2011). Therefore, the aim of the present study was to qualitatively examine the movement characteristics of the flat service in elite junior tennis players depending on speed, sex, and age group.
Methods
206 male (age: 13.2 ± 1.8 years, height: 163.2 ± 14.1 cm, body mass: 49.7 ± 13.4 kg) and 150 female (age: 13.0 ± 1.8 years, height: 158.2 ± 10.8 cm, body mass: 47.2 ± 10.8 kg) junior squad players of the German Tennis Federation matched into age categories (U12, U14, U16) participated in this study. During the standardized German Physical Condition Tennis Test all players were analysed for average and maximum serve velocity and were video recorded while performing the flat tennis serve (Sony PXW-FS5K; 240 fps; 60-Hz-HD-mode). Video data was analysed regarding to 24 selected qualitative movement characteristics (i.e. technique items, Inter-Rater Reliability: Cohens kappa: 0,3-1,0). Chi-square statistics were used to determine differences between performance level (fast and slow serving group), sex, and age group.
Results
Significant differences between subgroups of different service velocity were found in 5 items (e.g. toss, arm extension at impact (IP), forearm pronation) with higher values in the fast serving group. Comparing boys and girls, 13 items differed from each other (e.g. toss, weight transfer, foot position, take-off leg, arm extension at IP, shoulder over shoulder at IP, forearm pronation) with mostly higher values in boys. Within age groups, there was a subsequent increase from the U12 to U16 regarding the frequency of Items (e.g. elbow-position, knee flexion, take-off, arm extension at IP, shoulder over shoulder at IP, forearm pronation, wrist extension).
Discussion
Given the complexity of the service motion, results reinforce that the service is strongly dependent on several technical movement characteristics and suggests the importance of a perfect coordination of the partial movements. The study shows that arm extension at IP, shoulder over shoulder at IP and forearm pronation are important characteristics in girls (i.e. underdeveloped compared to boys). These Items, as well as take-off and knee flexion, are also of importance in young players to produce a high service velocity and should be focussed early during technical training.
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Contact
Dennis.Gatzke-s5b@rub.de

RELATIONSHIP BETWEEN THE YO-YO INTERMITTENT RECOVERY TEST LEVEL 1 AND THE TENNIS SPECIFIC HIT AND TURN TEST TO TENNIS PERFORMANCE

ULBRICHT, A.,FETT, J., VUONG, J., FERRAUTI, A.
RUHR UNI BOCHUM

Introduction
In addition to the predominant technical skills, tennis demands a complex interaction of several physical components. In this regard, aerobic fitness is an important component of tennis performance and enables to repeatedly generate explosive actions and ensures fast recovery between rallies (Ferrauti et al., 2011). In tennis, the use of semi specific field tests such as the YoYo-intermittent recovery test (YT1) is recommended (Fernandez-Fernandez et al.). However, no normative values are documented for the YT1 in tennis and there is no scientific information about the relationship to tennis performance and specific field tests. Therefore, the aim of the study was to analyze the relationship of the YT1 and a tennis specific test (HTT) (Ferrauti et al., 2011) to tennis performance as well as to provide age-related and sex-related normative values.
Methods
The anthropometric characteristics of 116 female (13.8 ± 1.7 years, 166.7 ± 14.2 cm, 54.0 ± 13.7 kg) and 180 male (13.7 ± 1.5 years, 163.2 ± 14.2 cm, 50.6 ± 9.6 kg) elite youth tennis players were examined. Subjects (age categories U12, U14, U16 and U18) completed the YT1 and the HTT on different occasions across the season. Pearson's correlation analysis was used to determine the relationship between the tests and tennis performance (ranking).
Results
Percentile values were estimated for different age groups for female and male tennis players. Significant correlations were found between ranking position and HTT (female overall r= -.50, U12 r= -.33, U16 r= -.38; overall male r= -.61, U12 r= -.57, U16 r= -.28) and YT1 (overall female r= -.31, U14 r= -.33; overall male r= -.59, U12 r=-.50, U14 r= -.32, U16 r= -.35, U18 r= -.38) and between the tests (male r= .73 and female r= .67).
Discussion
The results enable an accurate individual endurance profiling of junior tennis players. Overall the correlations between the specific HTT and tennis performance compared to the semi-specific YT1 were found to be stronger. The specific footwork and the upper limp work of the HTT seems to better reflect the tennis-specific workload profile than the YT1. Therefore, the HTT should be used to evaluate a players' specific endurance. However, a combination of both tests might obtain information about the transfer from semi-specific to specific actions (i.e. weakness or strength regarding the efficient use of hitting actions and specific footwork).
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TO EXAMINE THE RELATIONSHIP BETWEEN GOLF ABILITY AND PHYSICAL AND MOTORIC PERFORMANCE IN SCHOOL CHILDREN

ODABAS, I., TURAN, T., GÜLER, L., ASLAN, M., GÜLER, C.
HALIC UNIVERSITY, SCHOOL OF PHYISICAL EDUCATION AND SPORT

Introduction
The aim of the study was to examine between golf ability and physical and motoric performance.
Methods
Total 87 students aged 9-11 (mean age 9.7±0.7) participated in this study. 26 of the participants were female and 61 of them were male students. Balance, strength, flexibility, speed and muscular endurance were evaluated for motoric performance. Height, weight, skinfold

thicknesses were measured in order to evaluate physical structure and Cormique index was used for body fat percent, body mass index, leg length and body length. Four skills - starting position, club holding, hand-eye coordination and ball striking - were evaluated for golf ability. Each skill was marked from 1(the lowest) to 5 (the highest). Skills of the participants were evaluated by golf trainers. All data was evaluated by SPSS programme. The skewness was used to verify mean and standard deviation of the data and normality of the points. Pearson correlation was used for the relation between golf skills points and physical and motoric performances. Two Independent samples t-test was used for comparing according to the sex (0.05).
Results
As a result, it was determined that skill point of club holding of the children was 3,70±0,81; starting position point was 3,46±0,71; movement point was 3,37±0,93; and hand-eye coordination point was 3,33±0,97. A significant correlation wasn't found between the physical specialities and golf skills points of the participants (p>0, 05). It has been found that there was a significant positive correlation between the flexibility and golf skills points (r=0,23, p<0,05). There wasn't a significant correlation between the other motoric performance specialities and golf skills points (p>0,05). Also it has been determined that starting position points of the girls were significantly higher than the points of boys in comparing to sex (t=2,02, p<0,05). It hasn't been found a significant correlation between the other skills and golf skills points (p>0,05).

Mini-Orals

MO-SH06 Physical education and pedagogics

A STATUS QUO ANALYSIS ON RACKET SPORTS TEACHING IMPLEMENTATIONS IN GERMAN PRIMARY SCHOOLS

HOFFMANN, D., BRIXIUS, K., VOGT, T.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Physical education (PE) as a subject in German schools is often and controversially discussed in public and political debates. In the turn of the millennium, comprehensive educational reforms changed the task of PE in the federal school systems' context in North Rhine-Westphalia (NRW, federal state with the largest population in Germany). Thus, the curriculum stipulates the implementation of racket sports during the fourth school year. However, research examining the actual implementation of specific sports in PE is rare; in particular with a focus on primary schools. Therefore, the aim of this study was to analyze the actual implementation of racket sports at primary schools' PE, further addressing parameters that impact practical applied racket sport teaching.
Methods
551 NRW teachers volunteered to participate in this study (age: 44.91 ± 10.74 years, work experience: 17.17 ± 11 years as of male = 104, age: 49.49 ± 11.56, work experience: 21.82 ± 12.56 years and female = 433, age: 43.84 ± 10.16 years, work experience: 16.15 ± 10.29 years). All participants were teaching PE at primary schools in NRW. A standardized questionnaire, including closed and open questions in four thematic fields, was designed and sent using EvaSys®. Statistical analyses were computed using IBM SPSS 23® and Microsoft® Excel® 2011. Descriptive data calculated for the samples included frequency distribution and relative frequencies [%]. A chi-square test of independence was used, the level of significance was set at $P < 0.05$.
Results
69.9% (as of relevant 541 participants) of the teachers teach racket sports in their primary school PE classes. The questionnaire's item "Teaching racket sport in PE" was significantly related to "schools internal sport curriculum" (P=0.000), "work experience" (p= 0.001), "university degree in sport" (p=0.000) as well as "practicing racket sports during leisure time" (p= 0.000).
Discussion
A 69.9% implementation of racket sports in PE is in line with the NRW core syllabus. With the school internal sports curricula, the work experience, the university degree in sports, and practicing racket sports during leisure time having an impact on a teachers' implementation of racket sports in PE, further expanding racket sports into PE teachers' education may increase the implementation of racket sports in primary school PE classes.
Based on the present findings, it may be suggested that a change in study regulations, e.g. offering extra-occupational courses to teachers, may benefit the implementation of racket sports in primary school PE; however, additional research is necessary to examine possible impact differences between parameters and between different racket sports, e.g. Badminton, Tennis and Table Tennis.

NEUROMOTOR EXERCISE PROGRAM FOR CHILDREN INCREASES MENTAL AGE

REILLY, E., WILLIFORD, H., ALLEGRO, D., HIGGINBOTHAM, T.
AUBURN UNIVERSITY AT MONTGOMERY

Introduction
Problems with attention, concentration, reading and writing, and lack of coordination are issues that may be related to neuromotor immaturity, which in children is linked to lower academic performance (Blythe, 2009 & 2012; Melillo, 2011). Immaturity in vestibular and proprioception systems, retained primitive reflexes, poor posture and balance, and weak core strength have implications for learning and education. The purpose of this investigation was to evaluate differences in mental age after a six week neuromotor exercise program conducted at a primary school.
Methods
The subjects were 27 students in grades K-5 age 8.6 ± 2.0 years. Subjects were recruited from the school population. The program was held for 20 minutes per day, four days per week for six weeks. The exercise program consisted of games, activities, and exercises that have been shown to help integrate retained primitive reflexes and improve balance, coordination, and bilateral coordination. The typical session included specific exercises for integrating Asymmetric Tonic Neck Reflex (ATNR), Symmetric Tonic Neck Reflex (STNR), games and exercises incorporating core strengthening, vestibular system exercises, balance, and rhythmic bilateral coordination activities. Participants were tested for the presence of retained primitive reflexes, balance, and bilateral coordination using the Institute for Neuro-Physiological Psychology (INPP) test procedures. The Goodenough Draw-A-Person test was used to evaluate mental age. Descriptive statistics and Chi-square analysis was use to evaluate changes in the neuromotor function. A Paired T-test was used to evaluate overall changes in mental age. as ($P<0.05$).

Results
Participants testing positive for retained primitive reflexes showed significant improvements in indicators of neuromotor test performance. There was 300% increase in the number of students who passed the Romberg test (eyes closed), and a 70% increase in passage of the Romberg test (eyes open), 51% improved in ATNR, 40% improved in STNR, and 41% improved in Crossing the Mid-Line. Overall mental age improved from 8.1 ± 1.7 to 9.3 ± 2.1 years.
Conclusions
The results of this investigation indicate that a 6 week neuromotor exercise program can improve markers for neuromotor immaturity (such as poor bilateral coordination, presence of retained primitive reflexes, and poor balance), and increase mental age. After school physical activity programs improve neuromotor performance and increase mental age in elementary school children.
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THE JOINT PLANNING BETWEEN TEACHER AND STUDENT IN THE CHILDREN SPORT PROGRAM

REZENDE, D.

SESC- SOCIAL SERVICE OF THE COMMERCE

Introduction
Social Service of Commerce (SESC) is a private entity maintained by entrepreneurs of commerce, tourism and services. It aims to provide well-being and better life quality of workers and their families. The purpose of the Children Sport program is to present the world of body movement and stimulating the interest in learning about sports and physical activity. The aim of this work was to build the joint planning between teacher and student but also to verify the impact on the prevalence in choice of activities. Correia (1992) claims that in order to guarantee the child's access to knowledge, a process is required in the exercise of critical reflection in the choices and decisions within the educational process itself.
Methods
The SESC Santana unit has 21 students, 11 girls and 10 boys aged 6 to 9 years. The activities were divided in quarters: 1st Popular Games (PG), General Gymnastics and Athletics (GG; A); 2nd Games and Cooperative Games (G; CG); 3rd Adapted Sports (AS) and 4th Traditional Sports (TS). We ask the children to opt activities and at the end of the year the question is repeated to verify the impact of the experiences.
Results
The results of the first phase showed that 33.33% opted for the tag game, 23.81% dogdeball (PG), 23.81% futsal, 9.52% handball, 4.76% basketball and 4.76 % Volleyball (TS). At the end of the year the results were: 23.81% handball (TS) 19.05% for seated volleyball, goal kick, matball (AS) 9.52% tag game (PG), 4.76% for pioneerball and dogdeball (PG).
Discussion
The National Curriculum Parameters (portal.mec.gov.br/seb/arquivos/pdf/ciencias.pd) claim that defining or delimiting corporal practices are a risky task, because the subtle intersections, similarities and differences between one and the other are Linked to the context in which they are exercised. In this study, the prevalence of selected activities was modified according to the new practices. Bossle (2002) states that collective construction demonstrates flexibility in the decisions and actions of pedagogical doing. Therefore, opportunizing different games and activities can increase the motor repertoire as well as knowledge of different practices. Students participation in decisions was extremely significant in order to become active participants of the process.
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DEVELOPMENT OF AN EASY TO APPLY ASSESSMENT TOOL FOR PRE-SWIMMING SKILLS – A METHOD APPROACH IN (PRE)SCHOOL CHILDREN

STAUB, I.

GERMAN SPORT UNIVERSITY COLOGNE

The process of learning how to swim may be defined as four developmental stages: a) following a general familiarization to water, b) five basic aquatic skills (i.e. fully submerge, learn a rhythmic and steady breathing pattern with the added pressure of water, be able to float prone and supine using buoyancy, glide with reduced drag, and dive safely into the water) have to be mastered before c) basic aquatic locomotion is possible and d) swimming styles can be learned. Pre-swimming skills, consisting of water familiarization and the five basic aquatic skills, are prerequisite to move independently in the water. While there are different ways to quantify performance in swimming (e.g. time tracking, measurement of energetics, biomechanical analyses), evaluating pre-swimming skills often refers to the teachers' or coaches' experience and gut instinct. Therefore, this study aimed to develop an easy to apply assessment tool that quantifies the evaluation of pre-swimming skills to help estimating the stages of development in (pre)school children.
According to physical in-water characteristics, 19 consecutive and in level of difficulty increasing tasks were developed to capture the five basic aquatic skills. For each of the skills four to five tasks were differentiated. Each task was characterised by specific criteria. Criteria may be failed (end of assessment) or passed to then progress to the next level. Standard instructions will be provided verbally and in signage. 22 children (6.95 ± 1.03 years, male n=12, female n=10) covering the full range of task-difficulty were recruited as participants to perform the developed tasks. Performances were video recorded from standardized frontal (above and under surface) and sideways perspectives. Next, video sequences together with standardized evaluation sheets will be sent to three rating groups (each n=100) comprising different levels of experience in accordance to learning how to swim: swimming coaches, physical education teachers (elementary schools), and parents with children in the respective age group but no particular swimming or teaching history. Using the rating groups' evaluations, inter-rater reliability will be tested. If found reliable, the tool may be used in educational concepts and learning-to-swim.

PRESCHOOL MOTOR COMPETENCE AND ADOLESCENT PHYSICAL ACTIVITY: IS THERE AN ASSOCIATION?

VENETSANOU, F.1, KAMBAS, A.2, AVLONITI, A.2, STAMBOULIS, TH.2, LEONTSINI, D.3, DRAGANIDIS, D.3, CAHTZINIKOLAOU, A.2, FATOUROS, I.3

1:NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS, 2: DEMOCRITUS UNIVERSITY OF THRACE, 3: UNIVERSITY OF THESSALY

Introduction
Several cross-sectional studies have shown that in preschool age, motor competence (MC) is positively associated with children's participation in physical activity (PA) (Kambas et al., 2012; Williams et al., 2008), whereas longitudinal studies have documented that children with poor MC are inactive later in life (Cairney et al., 2010; Lloyd et al., 2014). The present study aimed at examining how physically active in their adolescence are children who had at least average-or higher- MC in their preschool age, in an attempt to understand whether an average MC level in early years is sufficient enough for achieving the recommended PA levels (Tudor-Locke et al., 2011).
Methods
One hundred and six adolescents (47 males, Mage =14.45 years, SD=.75) who had been examined with the Bruininks-Oseretsky Test of Motor Proficiency-Short Form (BOTMP-SF; Bruininks, 1978) when they had been preschoolers (Mage=4.96 years, SD=.57) and had been classified as having "average", "above average" or "well above average" MC, according to the BOTMP norms, volunteered to participate in the present study. Their PA was recorded with Omron HJ-720IT pedometers for seven consecutive days and a two way (MC level X gender) ANOVA on average steps/week was computed.
Results
A significant interaction between MC level and gender ($F=15.27$, $p<.001$, $\eta 2=.153$) was revealed. In males, only high MC adolescents presented higher PA (12112 steps) than those with above average MC (10398 steps) and average MC (11067), whereas in females significant differences among all MC groups were revealed (11810, 10537, and 7820 steps for high, above average and average MC females, respectively). Moreover, in above average and high MC groups, males and females had similar PA, whereas average MC males were more active than their female peers with the same MC. Among the MC groups, only average MC females failed to achieve ambulatory activity guidelines (Tudor-Locke et al., 2011).
Discussion
The MC in preschool age seems to positively associate with PA in adolescence. However, this association appears to be stronger for females than for males. Emphasis on the development of competent young movers could be beneficial for lifelong PA; nevertheless, especially for females, it seems that if they are to participate in PA later in their lives, the development of a high MC level in early years is important.
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ASSESSMENT OF SPORT INJURY PREVENTION MEASURES IN SCHOOLS WITH REGARD TO THEIR EFFECTIVENESS, APPLICABILITY AND ACCEPTANCE BY PHYSICAL EDUCATION TEACHERS AND PHYSIOTHERAPISTS

DIETERICH, S., KULIKOVA, O., KORTHALS, D.

HOCHSCHULE FÜR GESUNDHEIT

Introduction
Despite strongly standardized conditions and prevention efforts, about half a million injuries are registered in school sports in Germany every year. Many recommendations for injury prevention measures exist in the literature. However these recommendations mainly consider competitive sports and their effectiveness and not their applicability and acceptance, even though the latter are crucial for successful implementation. The objective of this study is to describe and compare the evaluation of different injury prevention measures in school sports in secondary education from a sports-pedagogical and physical therapeutic view. On the basis of a rating in effectivity, applicability and acceptance through experts, conclusions for the implementation of injury prevention measures are drawn.
Methods
The collection of data was acquired through a questionnaire, which was answered by 134 physical education teachers and 63 physical therapists. Injury prevention measures were divided in the categories "measures pre- and post-exercise", "sports equipment and facilities", "organization and supervision" and "supportive measures". The evaluations were acquired based on rankings and divided into moderate and strong ratings of experts.
Results
There was no significant difference in the evaluation by physical education teachers and physical therapists. The effectivity of injury prevention measures was rated higher than the applicability or acceptance in all categories. These categories and three criteria showed several significant variances.
Discussion
Minor time and equipment resources are held responsible for the low applicability of some injury prevention measures. Furthermore, a lack of motivation and motor competence in students might influence the evaluation of "acceptance". The majority of the experts emphasize the effectivity of measures regarding sports equipment and facilities, which are directly available, like suitable mats or inspecting sports equipment before use.
Contact
sven.dieterich@hs-gesundheit.de

Mini-Orals

MO-PM31 Elbow and knee

CORRELATION BETWEEN MEDIAL ELBOW PAIN AND ELBOW VALGUS INSTABILITY IN PREADOLESCENT BASEBALL PLAYERS

HIROYOSHI, M., HIROYUKI, W., TOMONORI, K., ATSUHIKO, M.
KITASATO UNIVERSITY GRADUATE SCHOOL

Introduction
Little leaguer's elbow, or medial apophysitis, is a common medial elbow injury in preadolescent baseball players. It is caused by valgus stress applied to the elbow during the late cocking and acceleration phases of pitching. Valgus instability in adolescent baseball players with elbow pain has been shown to be greater than in those without elbow pain. However, there are few studies related to elbow pain and valgus instability in preadolescent baseball players. The purpose of this study was to determine the relationship between valgus elbow instability and elbow pain in preadolescent baseball players.
Methods
This study was performed in the dominant and nondominant elbows of 46 preadolescent baseball players between the ages of 9 and 12, and subjects were divided into pain and normal groups based on the presence or absence of elbow pain. We evaluated elbow valgus instability using ultrasonography, and assessed pain around the medial epicondyle of the elbow. Valgus instability was assessed by measuring the width of the ulnohumeral joint space in the coronal plane and was calculated as the difference between the ulnohumeral joint space with and without gravity stress. The ulnohumeral joint space was the distance between the distal surface of the humerus and the proximal ulna. The difference in valgus instability between the pain and normal groups was assessed using a t-test.
Results
The pain and normal groups consisted of 6 and 40 baseball players, respectively. In the dominant elbow, valgus instability in the pain group was significantly greater than in the normal group (1.23mm vs 0.77mm, $P<0.05$). There was no significant difference between the pain and normal groups in valgus instability of the nondominant elbow (0.37mm vs 0.57mm).
Discussion
In the dominant elbow, preadolescent baseball players with pain in the medial epicondyle had greater valgus instability than those without pain. These findings suggest that valgus elbow instability is related to pain in the medial epicondyle. Previous studies in adolescents have shown that valgus instability in baseball players with elbow pain is more pronounced than in those without elbow pain. Our findings suggest that valgus instability is increased not only in adolescent but also in preadolescent baseball players with elbow pain. We conclude that valgus instability in the dominant elbow of preadolescent baseball players with elbow pain was greater than in those without elbow pain.

SITE-RELATED DIFFERENCE IN MUSCLE SIZE INFLUENCES BALLISTIC POWER-GENERATING CAPABILITY OF ELBOW FLEXORS

NAKATANI, M., MURATA, K., KANEHISA, H., TAKAI, Y.
NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

Introduction
Muscle volume (MV) is one of the determinants of power-generating potential (Wakahara et al. 2013). Power is theoretically product of force and velocity. Muscular strength is related to muscle size. It has been shown that sites where training-induced hypertrophic change within a muscle varies among the exercise modalities adopted. For example, while plyometric training elicits muscle hypertrophy at distal portion, resistance training does at proximal portion (Earp et al. 2015). However, it is unclear whether site-related difference in muscle size influences power-generating capability. The purpose of this study was to elucidate that site-related difference in muscle size affects power-generating capability during ballistic elbow flexion.
Methods
Sixteen gymnasts and 8 soccer players performed ballistic elbow flection at loads of 0, 15, 30, 45, 60 and 75% of maximal voluntary isometric contraction (MVC). During the tasks, elbow flexion force and elbow joint angle were determined. Velocity of elbow flexion was calculated from the displacement of elbow joint angle and length of lever arm. The subjects were required to flex the elbow joint as strongly and quickly as possible for all loads. Muscle thicknesses (MTs) of elbow flexors were determined using an ultrasound at 40, 50, 60 and 70% of upper arm length and normalized to upper arm length (MT/Ls). MV was derived from an equation reported in a prior study (Akagi et al. 2010).
Results
There were no significant group-related differences in MV and MVC. The significant difference in lever arm was found between both groups. MT/Ls at 50-70% were significantly higher in gymnasts than in soccer players.
Discussion
This suggests that, as compared to soccer players, gymnasts may predominantly develop at the distal portion of the elbow flexors. In all conditions, power, force and velocity during the ballistic elbow flexion were lower in gymnasts than in soccer players. The current results indicate that gymnasts had lower power-generating capability during ballistic elbow than soccer players, despite no significant group differences in MV and MVC force. The increase in MT at distal portion of elbow flexors during MVC changes the line of action (Akagi et al. 2013). The bulge during muscle shortening can cause many muscle fibers to be aligned more obliquely to the line of action (Maughan 1984). Considering these findings, the lower power-generation capability in gymnasts compared to soccer players may be assumed to be due to the difference in the magnitude of muscle size at the distal portion of elbow flexors.
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Contact
m157007@sky.nifs-k.ac.jp

USEFULNESS OF SELF-CHECK FOR ELBOW AND SHOULDER PAIN IN ADOLESCENT BASEBALL PLAYERS ~COMPARISON OF EARLY AND LATE ADOLESCENCE~

YUSUKE, S., MASAHIRO, S.

HACHIOJI SPORTS CLINIC

Introduction
Reliability and validity of the the orthopedic special test for baseball players are high, for example, Moving Valgus Stress Test (MVST)(O'Driscoll et al., 2005) and Posterior Impingement Sign (PIS)(Meister et al., 2004). It is easy to perform these tests. They are useful for early detection of throwing injury and have clinical value.
Then, if these useful tests are performed between players in the sports field, it will lead to further early detection and prevention of throwing injuries. This study is aimed to investigate usefulness of self-check for elbow and shoulder pain in adolescent baseball players, and whether it differs between the generations.
Methods
The subjects were 106 baseball players who participated in medical check. The subjects were divided into two groups: early (8-15yo; 76 players) and late (16-18yo; 30 players) adolescent. MVST and PIS were performed by two physical therapists, and each of two self-checks were performed between players with similar maneuver to the special tests. We calculated sensitivity, specificity, positive (LR+), and negative likelihood ratios (LR-) from provided results.
Results
In early adolescent group, the sensitivity, specificity, LR+ and LR- of self-check for MVST were 0.75, 0.94, 12.75 and 0.27. Those of self-check for PSI were 0.20, 0.92, 2.37and 0.87. In late adolescent group, the sensitivity, specificity, LR+ and LR- of self-check for MVST were 0.50, 0.96, 14.00 and 0.52. Those for PSI were 1.00, 0.89, 9.00 and 0.00.
Discussion
MVST is highly sensitive for medial elbow pain arising from the medial collateral ligament(O'Driscoll et al., 2005). In addition, PSI has highly sensitive for undersurface tearing of the rotator cuff and tearing of the posterior labrum during overhand athletics(Meister et al., 2004). In this study, self-checks which are similar to these special tests were performed, and then self-check for MVST showed high validity in early adolescent group, and self-check for PSI showed high validity in late adolescent group. Early adolescent players have much elbow injuries(Matsuura et al., 2016), and the ratio of shoulder injury increases with age(Tyler et al., 2014). As a consequence of this study, self-checks have possibilities of helping early detections of the injury with high incidence or high disease severity in each generation.
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Contact
lamy.sato1989@gmail.com

TREATMENT OF LATERAL EPICONDYLOSIS USING ALLOGENEIC ADIPOSE-DERIVED MESENCHYMAL STEM CELLS: A PHASE II DOUBLE BLIND RANDOMIZED CONTROLLED TRIAL

CHUNG, S.

SEOUL NATIONAL UNIVERSITY AND HOSPITAL

Introduction
Allogeneic preparation of stem cells provides certain advantages of being readily available and not requiring invasive procedures, which would facilitate application of stem cell therapy on intractable but non-life threatening conditions such as recalcitrant lateral epicondylosis (LE). The authors conducted a phase I clinical trial to apply allogeneic adipose-derived mesenchymal stem cells (allo-ASC) on 12 LE patients to show its safety and potential efficacy, previously. This study aimed to evaluate efficacy of allo-ASC in treatment of LE through a double blind randomized controlled trial.
Methods
A total of 11 participants with clinical and ultrasonographic diagnosis of chronic LE were recruited. Participants were randomly assigned to undertake ultrasound guided injection of 106 cells/mL of allo-ASC mixed (treatment group) or normal saline (control group) with fibrin glue at the largest hypo-echoic lesion of the common extensor tendon. After monitoring safety for 2 weeks, the other 6 ones (Group 2) were administrated with 107 cells/mL of allo-ASC. After safety was evaluated at 3 days and 2 weeks, safety and efficacy were determined at 6, 12 weeks, 6, and 12 months from injection by visual analog scale of elbow pain, and qualitative grading of tendon injuries rated by three and two specialists for ultrasound and MRI, respectively.
Results
Neither serious nor clinically significant adverse effects were observed until 12 months. Decrease of pain was observed in both groups at 12 months follow-up from 3.2±2.4 to 0.3±2.3 versus 4.6±1.6 to 0.9±1.3 for the cell versus control groups, respectively. Improvements in Ultrasound images were also shown in both groups at 12 months follow-up with a tendency that the cell group had better score (4.0±0.9) than the control (3.8±0.4). No statistical significances were achieved in either parameters.
Discussion
Because of small differences with a small sample size, this trial provides an inconclusive result for comparing efficacy of stem cell therapy with controls. However, the patterns of improvement should be noted both in pain and anatomical structures. Further trials with a larger sample size should be followed.

EFFECT OF A PROGRESSIVE AND MONITORED MUSCLE STRENGTHENING PROGRAM ON THE DEVELOPMENT OF UPPER LIMB STRENGTH IN PEOPLE DIAGNOSED WITH FIBROMYALGIA.

MAESTRE-CASCALES, C.1, CALDERÓN-MONTERO, J.1, ROJO-GONZÁLEZ, J.J.1

1. FACULTY OF PHYSICAL ACTIVITY AND SPORT SCIENCE (INEF). TECHNICAL UNIVERSITY OF MADRID.

Introduction

Fibromyalgia (FM) affects approximately 1-3% of the general population. A common symptom is the loss of strength or muscular weakness, especially in the upper body, which affects the ability to perform tasks of daily life, such as lifting and transporting objects or working with arms and hands in high positions. Therefore, the result is that the quality of life of these people is especially reduced, existing a relationship between functionality and increase in strength. The aim of this study was to increase upper-arm strength after 23 weeks of progressive strength-resistance work.
Methods
A total of 41 women diagnosed with FM (53±9.51 years) participated in the muscular strengthening program with progressive work distributed in three phases. Values were taken in the arms and shoulder girdle muscles, by means of repetitions using the SFT battery and foot dynamometer (TKK-5402). The forearm-hand strength was also assessed by a manual dynamometer (T.K.K.-5101). All participants completed the Global Physical Activity Questionnaire (GPAQ), sociodemographic questionnaire, and the Revised Fibromyalgia Impact Questionnaire (FIQR)
Results
The data were processed with the statistical program SPSS version 21. Significant improvements in arm flexor muscle strength were found, both in repetitions ($p = 0.00$), with a percentage improvement on the dominant side of 104% and non-dominant side of 91%, as in dynamometry with increase of 261%. It also increases the strength in the musculature manual-forearm ($p = 0.00$) reaching 26% in dominant side and 20% in non-dominant side, showing significant differences in both sides.
Discussion
People affected with FM show a chronic inflammatory state that, together with the decrease in levels of physical activity, can increase the muscular inability. We appreciate a remarkable improvement in the levels of strength in upper train allowing to regulate the inflammation and to improve the muscular quality which achieving to realize activities of the daily life that previously were incapable. Previous studies correlated positively with manual pressure dynamometry with life expectancy (Metter et al., 2002 & Al Snih et al., 2002
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Contact
Cristina.maestre@upm.es

THE INFLUENCE OF CONTRALATERAL HIP BENDING ON KNEE VALGUS ANGLE AND THE ACTIVITIES OF ABDOMINAL AND HIP ABDUCTOR MUSCLES DURING SINGLE-LEG SQUATS

ASO, T.1, KAGAYA, Y.2

1:SHOWA UNIVERSITY FUJIGAOKA REHABILITATION HOSPITAL (YOKOHAMA, JAPAN), 2:SCHOOL OF NURSING AND REHABILITATION, SHOWA UNIVERSITY

Introduction
It is considered that dynamic knee valgus is the primary predictors of anterior cruciate ligament (ACL) injury risk. The screening test using single-leg squats has been used to evaluate dynamic knee valgus, which is suggested to associate with hip abductor dysfunction. However, little is known about the influence of abdominal muscle on dynamic knee valgus during single-leg squats. Therefore, the aim of this study was to investigate the influence of difference in contralateral hip position on knee valgus angle and the activities of abdominal and hip abductor muscles during single-leg squats.
Methods
Eight healthy basketball players (12 legs) participated in this study (age: 20.7± 1.2 years, height: 166.0 ± 9.1 cm, weight: 57.3 ± 7.2 kg).The subjects performed two kinds of single-leg squats ,which were contralateral hip straight in non-weight bearing side (HS) and hip bent to 60°in non-weight bearing side (HB). This procedure was recorded using a 3D motion capture (VICON) and surface electromyography (EMG).Knee and hip kinematics were measured using the VICON. Surface EMG data was recorded for each external oblique, transversus abdominis-internal oblique (TrA-IO), rectus abdominis, erector spine, gluteus medius (GM) and tensor faciae latae. Each EMG activities were calculated the root mean square for 1 second until maximal knee flexion, and normalized by maximal voluntary contractions. Paired t-test were used to compare EMG activities and 3D kinematic variables between HS and HB. Pearson's correlation coefficient were used to examine the relationships between hip abductor muscle activations in weight bearing side and abdominal muscle activations. The significance level was set at $p < 0.05$.
Results
With regard to the weight bearing side, GM muscle activity in HB was greater than in HS ($p<0.02$). Knee abduction angle in HB was smaller than in HS ($p<0.05$). Hip adduction angle in HB was smaller than in HS ($p<0.02$).
GM muscle activity in weight bearing side had positive correlation with TrA-IO muscle activity (non-weight bearing side: $r=0.768$, $p<0.01$, weight bearing side: $r=0.696$, $p<0.02$) in HB.
Discussion
Our results revealed that contralateral hip bending during single-leg squats decreased dynamic knee valgus. Additonally, GM muscle activity had positive correlation with TrA-IO. Hodges et al. reported that TrA demonstrated to be active prior to movement of lower limbs. Shimizu et al. reported that contraction of the abdominal muscles increased GM muscle activation during hip abduction in side lying. Based on these findings, it is quite possible that local muscle activation has an important role in prevent dynamic knee valgus during single-leg squats.

EFFECT OF INFRAPATELLAR BRACE ON PAIN AND JUMPING PERFORMANCE IN PATELLAR TENDINOPATHY AMONG YOUNG ATHLETES

DAR, G., MEI-DAN, E.

UNIVERSITY OF HAIFA

Introduction
Infrapatellar brace/strap is a treatment technique extensively used in rehabilitation of patellar tendinopathy; however, its effect on pain and functional performance in among young athletes has not been studied.
Methods

The sample studied included sixteen male basketball and volleyball young athletes (age range 12-18 years) diagnosed with patellar tendinopathy. Infrapatellar brace was applied beneath the patella, over the patellar tendon. The athletes performed four jumping tests: Squat jump test, Drop jump test, Single leg jump test and Jumps 30 seconds test, with and without the brace. The test order and use of the brace was randomly changed for each subject. Pain severity in the symptomatic knee during jumping tests was assessed using a visual analog scale, and jumping performance parameters were assessed using an Optojump Next optical measurement system. Jumping performance included: flight time (converted to jump height), gravity acceleration (flight time and contact time converted to power in watt/kg) and coefficient of variation for the 30 second jumps.
Results
Pain severity reported by the participants decreased in Drop test, Single leg jump test and Jumps 30 seconds test while using the infrapatellar brace compared with no brace condition ($p<0.05$). No significant difference in jumping performance was found between jumping with and without the brace.
Conclusion
The infrapatellar brace was effective in reducing local pain among young male athletes without disturbing jumping performance.

EFFECTS OF ISOLATED GLUTEAL MUSCLE FATIGUE ON KNEE VALGUS DURING A RUNNING TASK: IMPLICATIONS FOR INJURY AND COACHING.

CONNOR, L., HEADEY, J., GISSANE, G., LINEHAM, J.
ST MARYS UNIVERSITY

Introduction
Knee Valgus is widely reported to increase athletes' risk of injuries such as Patellofemoral pain and Anterior Cruciate Ligament Ruptures. It is also reported to delay the onset of maximal force production and thus, decrease athletic performance. The gluteal muscles have been shown to resist valgus motions. Fatigue is widely accepted to reduce the force capabilities of muscles. Thus, fatigue of the gluteal muscles may influence knee kinematics. The purpose of this study was to assess the relationship between isolated gluteal muscle fatigue and knee valgus in field-sport athletes during a running task.
Methods
Two-dimensional kinematic data was collected from 20 participants while performing a running task. Participants then completed an isolated gluteal muscle fatigue protocol using the CLAM exercise, followed immediately by a repeat of the running task.
Results
Following the gluteal muscle fatigue protocol, peak frontal plane knee angle changed from 184.57(4.59)° to 183.39 (4.28)°. This represents a significant difference ($t = 2.485$, $P = 0.025$).
Discussion
This study demonstrates a small but significant difference in knee valgus following gluteal fatigue. These changes could be associated with increased risk of injury and decrease in sporting performance. Furthermore, increased gluteal muscle strength showed a decrease in knee valgus in this study. Consequently, interventions aimed at increasing strength of the gluteal muscles may provide some protective effect against knee injury. This study also showed a significant relationship between greater gluteal strength and reduced knee valgus angles. These findings have implications for training and injury prevention programs.

16:15 - 17:45

Invited symposia

IS-PM10 Strategies for optimizing elite endurance exercise performance

NUTRITIONAL STRATEGIES FOR OPTIMIZING ELITE ENDURANCE EXERCISE PERFORMANCE

JEUKENDRUP, A.E.
LOUGHBOROUGH UNIVERSITY

Especially in endurance sport nutrition has been shown to be an important factor. Nutrition plays an important role in performance during an event, the recovery from exercise and the adaptation long term.
It has been known since the 1960s that muscle glycogen plays an important role and as such strategies to start exercise with high glycogen stores have received a lot of attention. Also carbohydrate and fluid intake during exercise have been shown to have ergogenic effects by preventing drops in carbohydrate oxidation, blood glucose concentrations and dehydration. There are guidelines that give advice based on the duration of exercise and based on the daily training volume. There is no distinction between the guidelines for men and women, for trained and untrained athletes and for young and older athletes. Partly this is because most research is done in young men who are by no means elite athletes (and also do not represent the recreational end of the spectrum of athletes). Partly, however, this is based on a limited number of studies that show no difference in carbohydrate delivery in trained and untrained, men and women. In some events gut function (delivery of fluids and carbohydrate) is critical and therefore "training the gut" is an often recommended strategy. The gut is an extremely plastic organ that can adapt relatively quickly to different stimuli (dietary changes). There are a number of other ergogenic aids that are often used by athletes. Caffeine is the one with the most evidence. Even relatively low doses (3 mg/kg) of caffeine seem to have effects on endurance performance. Other supplements like nitrates (beet root juice), bicarbonate and beta-alanine have much less evidence, especially in very well trained athletes.
Recovery is an important factor especially with repeated days of hard training and competition. In this phase, replenishing carbohydrates and fluids are the main factors. Protein is often consumed by athletes but evidence that this affects short term recovery is scarce. The effects of protein are believed to be longer term effects where we refer to "recovery" as training adaptation. It is also believed that some measures to speed up short term recovery could actually harm long training adaptation. Therefore, the goals of nutrition interventions must be very clear. Sound nutrition planning for athletes involves a strategy and a planned approach. This is often referred to as periodized nutritrion, a long term plan is created that takes into account both short term and long term goals, with the ultimate goal to optimise the athlete's performance.

HIGH INTENSITY INTERVAL TRAINING AND PERIODIZATION

RØNNESTAD, B.R.

INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES

High intensity aerobic interval training (HIT) have been utilized for improving athletes` endurance performance for approximately a century. It is clear that HIT is an important part of endurance athletes` training program. Prescription of HIT contains a number of variables that can be manipulated in different ways resulting in different acute stimulus and subsequent different long-term adaptations. The main variables are intensity and duration of work and relief intervals. In traditional endurance sports, like cycling, running and cross-country skiing, usually longer intervals (4-6 min) are preferred before shorter intervals (e.g. 30 sec). Time above 90% of maximal oxygen consumption is one of the main acute variables used to optimize HIT. The first part of this presentation will focus on the effects of shorter and longer high intensity aerobic intervals on endurance performance in typical endurance sports. The last part focuses on how to organize the HIT sessions on a weekly basis. In general, it can be argued that the traditional way of implementing HIT is to regularly perform ≈2 HIT sessions per week interspersed with low and moderate intensity endurance training. However, it has lately been indicated that organizing the training in distinct blocks with selective focus on one or a few training stimulus, for example focusing on HIT, can be a good alternative for certain training periods in elite endurance athletes.

Invited symposia

IS-PM05 HOT TOPICS IN ALTITUDE MEDICINE AND ALTITUDE TRAINING

THE BRAIN IN ACUTE MOUNTAIN SICKNESS AND HIGH ALTITUDE PULMONARY EDEMA

BÄRTSCH, P.

HOEHENMEDIZIN.EU

Ascent to altitudes above 2500 m can cause acute mountain sickness (AMS), which may progress to high altitude cerebral edema (HACE). AMS is characterized by headache, lassitude, anorexia and nausea/vomiting, which are all usually self-limiting with a day of rest and symptomatic treatment. Truncal ataxia and altered consciousness are the cardinal symptoms of HACE, which is often lethal when not treated with oxygen, dexamethasone and descent. Slow ascent, or acetazolamide, or glucocorticosteroids during ascent can attenuate or prevent these illnesses.

The pathophysiology underlying the cerebral symptoms of AMS is unclear. Several mechanisms could activate pain sensitive structures and vegetative centers in the brain. Candidates are brain edema and increased intracranial pressure (ICP), distension of large vessels because of increased cerebral blood flow (CBF) in hypoxia and possibly impaired autoregulation of CBF, restricted venous drainage of the brain, activation of the trigemino-vascular system by hypoxia, or increased permeability of the blood brain barrier (BBB) in hypoxia with release of inflammatory mediators. It is conceivable that several of these factors are involved in the pathophysiology of AMS, since no single factor is strongly associated with the development of AMS.

Increased ICP and vasogenic edema located predominantly in the corpus callosum (CC) are consistent findings in HACE. Hemosiderin depositions in the CC usually detectable by susceptibility weighted MRI after HACE indicate leakage of red blood cells through the BBB and are footprints of HACE. Increased CBF, impaired venous outflow and increased vascular permeability may all contribute to the BBB leak in hypoxia.

HBMASS AND ALTITUDE – AN UPDATE FOCUSSING ON PERFORMANCE, TRAINING AND HEALTH

SCHMIDT, W.

UNIVERSITY OF BAYREUTH

At sea level, hemoglobin mass (Hbmass) is closely related to aerobic performance and the change in Hbmass by 1g changes VO2max by 4ml/min. Elite endurance athletes, therefore, possess at least 40% more hemoglobin than sedentary subjects and training at altitude is frequently used as a tool to increase Hbmass and thereby aerobic performance. Cross sectional studies comparing altitude dwellers with residents from sea level show elevated values of approx. 11% at 2600m and 15% at 3.600m. East African runners, however, grown up above 2200m do not possess more hemoglobin than Caucasian athletes proving other mechanisms like running economy as more important for their excellent performance. When athletes from lowland train at altitude (3-4 weeks at 2000m – 2500m) they show a very different individual erythropoietic response ranging between no effect until a 12% increase in Hbmass. In the mean, Hbmass increases by 1% per 100h in hypoxia, equally if athletes use LH-TH or LH-TL protocols. Immediately after return from high altitude (5300m), there occurs a significant neo-cytolysis which destroys the majority of the additionally produced red cells. Upon return from moderate altitude, however, no hemolysis occurs and there exists a significant relationship between the change in Hbmass and VO2max. Three weeks after return, when already 50% of the gained Hbmass has disappeared best performance has been determined. Other short-term hypoxic training measures, like intermittent hypoxic training, do not affect erythropoiesis. Due to suppressed hypoxic ventilatory response patients living at about 4000m and suffering from chronic mountain disease increase their Hbmass by more than 100% compared to healthy subjects from identical altitude. This results in hematocrit values reaching up to 80% leading to severe cardio-circulatory and cerebral health problems and reduced performance. The most effective therapeutic measure is to move to lower regions which quickly results in normalization of Hbmass and hematocrit values. Another promising therapeutic measure for these patients is the administration of acetazolamide which increases the oxygen availability and reduces Hbmass.

BEST PRACTICES IN ALTITUDE TRAINING FOR TEAM SPORTS

GIRARD, O.

ASPETAR ORTHOPAEDIC AND SPORTS MEDICINE HOSPITAL

Historically, altitude training emerged in the 1960s and was limited to the "Live High Train High" method for the endurance athletes looking for increasing their hemoglobin mass and the oxygen transport. This "classical" method was completed in 1990s by the "Live High Train Low" (LHTL) method where athletes, including team-sport players, benefit from the long hypoxic exposure and from the higher intensity of training at low altitude. Innovative "Live Low Train High" methods were proposed recently as repeated sprint training in hypox-

ia (RSH), resistance training in hypoxia or remote ischemic preconditioning, presumably with peripheral adaptations postponing muscle fatigue. RSH efficiency likely relates to the compensatory vasodilatory effects on fast twitch fibers behavior leading to an improved oxygen extraction by these fibers. Observations of greater amplitudes of muscle blood perfusion variations post-RSH, suggesting enhanced muscle blood flow, support the above hypothesis of greater oxygen utilization by fast twitch fibers after this particular intervention.
Beyond all these recent improvements, a combination of different hypoxic methods can be used for maximizing the benefits and reducing the main drawbacks of each one. Compared to "traditional" LHTL, by combining LHTL and RSH ("Live High Train Low and High"; LHTLH) where athletes live high and train low except for few intense workouts in altitude additional benefits regarding RSA (twice larger gains that were maintained at least for 3 weeks post-intervention) have been reported in elite field-hockey players, while gains in hemoglobin mass and in specific aerobic performance were similar. The superiority of LHTLH to LHTL was further demonstrated by an up-regulation of the mRNA expression of factors implicated in the regulation of oxygen signaling and transport, mitochondrial biogenesis as well as enzymes of mitochondrial metabolism.
In summary, the panorama of the hypoxic methods for team sports is now wider than in the past with the recent development of innovative methods to improve various aspects of in-game physical performance. This presentation aims to present and discuss the recent updates on altitude/hypoxic training (advancements and limitations) for team sports. Practical recommendations for implementation of these new methods will also be discussed. For instance, mobile hypoxic inflatable marquees - directly located on the playing ground - are now available; this opens new boundaries in future advancements of hypoxic training applications in team sports.
Contact
oliv.girard@gmail.com

Oral presentations

OP-PM14 Body Composition

WATER LOADING IN COMBAT SPORT ATHLETES AS A MEANS TO ACUTELY MANIPULATE BODY MASS

REALE, R.1,2, DUNICAN, I.3, SLATER, G.2, COX, G.1,2, BURKE, L.1,4

1: AUSTRALIAN INSTITUTE OF SPORT, 2: UNIVERSITY OF SUNSHINE COAST (AUSTRALIA), 3: UNIVERSITY OF WESTERN AUSTRALIA, 4: AUSTRALIAN CATHOLIC UNIVERSITY

Introduction
Athletes in weight category sports practice various methods of acute weight loss. Commonly used methods centre around dietary and fluid restriction or increased exercise; however the use of novel methods is noted. Recent research and long standing "grey literature" demonstrates the popularity of 'water loading' (the consumption of large volumes of fluid for several days, prior to withholding intake) as a means to increase body water losses following fluid restriction. No research has examined this technique or its possible risk of causing hyponatremia. Thus we sought to determine the effectiveness and safety of water loading and assess potential mechanisms.
Methods
Male combat sport athletes (n=21, 77.5±8.1kg 177.5±6.1cm, 26.6±4.0years) were separated into a control (CON, n=10) and water loading (WL, n=11) group. Subjects were fed a standardised isoenergetic diet based on fat free mass (assessed via DXA scan) controlling for macronutrient, sodium and fibre content for 6 days. Day 1-3 fluid intake was 40mL/kg CON and 100mL/kg WL. Day 4 fluid intake was 15mL/kg CON and WL. Day 5 no fluid was consumed until midday with both groups following the same rehydration protocol until day 6. Urine sodium, specific gravity (USG) and volume were recorded alongside training sweat losses and sleep quality/ duration (measured via actigraphy) throughout. Renal hormones (vasopressin, renin, and aldosterone), blood urea and electrolytes (U+Es) and body mass (BM) were measured each morning (fasted) and evening following 30 min supine rest. Physical performance was assessed pre and post intervention. Two way repeated measures ANOVAs were used to assess differences between groups.
Results
Following fluid restriction, significant differences with large effect sizes were found in fluid input/output ratio (39.11%, $p < 0.01$, ES=1.2) and BM loss (0.6%BM, p=0.02, ES=0.82). No differences in sleep or performance measures existed. Time had a significant effect on USG, all U+Es and renal hormones ($p < 0.05$). An interaction existed between time and intervention on blood sodium, potassium, chloride, urea, creatinine, USG and vasopressin ($p < 0.05$) but not on other hormones or electrolytes. No mean U+Es differed from reference range or approached critical values.
Conclusion
Water loading appears to be a safe and effective method of acute BM loss under the conditions utilised in this study. Changes in vasopressin may in part underlie the mechanism facilitating this technique.
Contact
Reid.reale@ausport.gov.au

A STEP TOWARDS REMOVING PLASMA VOLUME VARIANCE FROM THE ATHLETE'S BIOLOGICAL PASSPORT: THE USE OF BIOMARKERS TO DESCRIBE VASCULAR VOLUMES FROM A SIMPLE BLOOD TEST

LOBIGS, L., SOTTAS, P.E., BOURDON, P.C., NIKOLOVSKI, Z., EL-GINGO, M., VARAMENTI, E., PEELING, P., DAWSON, B., SCHUMACHER, Y.O.

UNIVERSITY OF WESTERN AUSTRALIA

Introduction
The hematological module of the Athlete's Biological Passport (ABP) has significantly impacted the prevalence of blood manipulations in elite sports. However, the ABP relies on a number of concentration-based markers of erythropoiesis, such as hemoglobin concentration ([Hb]), which are influenced by shifts in plasma volume (PV). PV variance currently represents the majority of biological variance associated with volumetric ABP markers. A recent study identified a panel of common chemistry markers (from a simple blood test) capable of describing ~67% of PV variance, presenting a practically applicable method of accounting for PV fluctuations within anti-doping practices (Lobigs et al., 2017).
Methods

Here, this novel PV marker was applied to the ABP Bayesian Network. Over a 6-month period (one test per month), 33 healthy, active males provided blood samples and performed the CO-rebreathing method (Schmidt and Prommer, 2005) to record PV (control). In the final month participants performed a single maximal exercise effort to promote a PV shift (mean PV decrease -17%, 95% CI -9.75 to -18.13%). With the ABP adaptive Bayesian model, individualized reference limits for [Hb] and the OFF-score were created, with and without the PV correction.
Results
With the PV correction, 66% of within-subject variance is removed, narrowing the predicted reference limits for [Hb] and the OFF-score, and reducing the number of atypical ABP findings post-exercise. Despite an increase in sensitivity, there was no loss of specificity with the addition of the PV correction.
Discussion
Adjustments for PV has the potential to significantly improve the sensitivity of the ABP, enhancing our current abilities to detect blood doping by removing the confounding effects of PV variance. The method, requiring only a simple blood test, provides a practical solution to improve current anti-doping testing protocols. It is hypothesized that the model, with its multi-parametric approach and weighting function, maintains the capacity to describe vascular volumes in cases of pathology or substance abuse, so long as only one biomarker is affected. Further validation of this method during blood manipulation research studies is suggested.
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Contact
Louisa.lobigs@research.uwa.edu.au

COMPARISON OF TWO MULTIFREQUENCY BIOIMPEDANCE DEVICES IN ASSESSING BODY COMPOSTION, HYDRATION STATUS AND BASAL METABOLIC RATE.

SÁNCHEZ-DELGADO, A.1, ESPAÑA-ROMERO, V.1, PONCE-GONZÁLEZ, J.1, PÉREZ-PÉREZ, A.1, VELÁZQUEZ-DÍAZ, D.1, LÓPEZ, J.2, ÁLVAREZ-REY, G.2, JIMÉNEZ-PAVÓN, D.1
UNIVERSITY OF CÁDIZ

Introduction
Bioimpedance analysis (BIA) for measuring body composition and hydration status is widely used. However portable devices that facilitate the implementation and usage of BIA have been lately developed and its accuracy needs to be studied. We compared parameters of body composition, hydration status and basal metabolic rate from a newly developed BIA (BIODYXPERTZM (BE)) with a validated BIA (TANITA-MC780MA; TT) in young adults.
Methods
A total of forty-one young adults (15 female) participated in a comparison protocol designed to analyse the level of agreement between the new BE, a portable BIA, and a the multifrequency TT-BIA. Forty-one (15 female) participants aged (21.5±1.9y) followed an euhydration protocol during the week before the BIA assessment day. Body composition, i.e., percentage of body mass (%BF), fat mass (kg), fat free mass (kg) and bone mineral content (g); hydration status, i.e., extracellular, intracellular and total body water (all in litres); and basal metabolic rate were estimated by both, BE and TT, BIA analyzers.
Results
Moreover, BE estimated lower values [bias (95% limits of agreement)] for fat mass (-2.83 (-6.76 to 1.10)) and basal metabolic rate (-4.62 (-164.30 to 155.06)) and higher values for fat free mass (2.87 (-1.08 to 6.81)), bone mineral content (0.002 (-0.29 to 0.29)), intracellular (1.98 (-1.17 to 5.13)), extracellular (1.27 (-0.16 to 2.70)) and total body water (3.25 (-0.64 to 7.14)). There were significant positive correlations between all parameters (but bone mineral content) measured by BE and TT analyzers (r=0.94 to 0.99 for body composition variables; r=0.96 to 0.97 for hydration status variables and; r= 0.96 for basal metabolic rate). Similar results were found when analyses were performed by gender.
Discussion
Both methodologies rank individuals similarly, suggesting that BE-BIA may be used to assess body composition, hydration status and basal metabolic rate in young adults.
Contact
david.jimenez@uca.es
alejandro.sanchezdelgado@alum.uca.es

EXERCISE TRAINING COMBINED WITH INTERMITTENT FASTING AND ALKALINE SUPPLEMENTATION AS EFFECTIVE STRATEGY TO REDUCE BODY WEIGHT AND IMPROVE RUNNING PERFORMANCE

HOTTENROTT, L., WERNER, T., VORMANN, J., HOTTENROTT, K.
INSTITUTE FOR PERFORMANCE DIAGNOSTICS AND HEALTH PROMOTION

Introduction
Intermittent fasting (IF) is a strategy for weight loss with high feasibility. In particular IF combined with exercise has been suggested to enhance weight loss. However, both procedures might negatively influence acid base status. Therefore, the aim of this study was to determine combined effects of IF, exercise training and alkaline supplementation in overweight subjects.
Methods
80 overweight subjects of age 45.5±7.8 years were assigned to different dietary strategies: IF and non-intermittent fasting (nIF). Further on, subjects were randomly assigned to take either an alkaline supplement (IF-v, nIF-v) or a placebo (IF-p, nIF-p). All subjects performed a personalized endurance training (3-4 times a week). Body weight, body composition, running performance and acid-base parameters were determined before and after the 12 weeks program.
Results
There was a significant effect on body weight, body fat, visceral fat and running performance in all groups ($p < 0.01$). Compared to nIF, IF significantly increased body weight loss (IF-p: -5.80±0.77 kg and nIF-p: -3.40±0.58 kg). In both dietary strategies, weight loss was significantly further enhanced by alkaline supplementation. The increase in running velocity was significantly higher in IF combined with alka-

line supplementation (IF-v 1.73±0.23 and IF-p 0.97±0.20). In addition, supplementation increased HCO3- plasma concentration and urinary pH.
Conclusion
Exercise training in combination with IF and alkaline supplementation is an effective strategy to reduce body weight and improve running performance.

Oral presentations

OP-PM15 Energy metabolism and hormones

THE EFFECT OF EXERCISE ON APPETITE AND APPETITE-REGULATORY HORMONES IN SUBJECTS WITH THE FTO RS9939609 POLYMORPHISM.

DORLING, J.L., CLAYTON, D.J., JONES, J., KING, J.A., PUCCI, J., BATTERHAM, R.L., STENSEL, D.J.
LOUGHBOROUGH UNIVERSITY; UNIVERSITY COLLEGE LONDON

Introduction
The fat mass and obesity associated gene (FTO) rs9939609 A allele is related to obesity (Frayling et al., 2007), greater food intake (Cecil et al., 2008) and impaired postprandial reduction of ghrelin (Karra et al., 2013). Exercise suppresses levels of ghrelin and appetite (Broom et al., 2007), yet the effect on obesity-prone traits linked to the rs9939609 A allele is unknown. This study assessed the effect of exercise on appetite, appetite-regulatory peptides and energy intake in variants of the FTO rs9939609 polymorphism.
Methods
From a sample of 202 European males genotyped for FTO rs9939609 variant, 12 AA and 12 TT participants completed two lab-based trials, exercise and control, in a counterbalanced design. In the exercise trial, participants ran for 60 minutes and then rested for 7 hours, while participants rested for 8 hours in the control trial. A test meal and an ad libitum meal were consumed at 1.5 hours and 6.5 hours, respectively. Appetite ratings and appetite-regulatory peptides were measured frequently during each trial.
Results
Exercise caused greater suppression of acylated ghrelin in AAs than TTs (AA: 24.0 ± 3.6 vs TT: 14.3 ± 1.7 fmol·mL-1 x h; mean ± SEM; $P < 0.05$). Greater postprandial appetite ratings and energy intake were displayed across both trials (exercise and control) by AAs compared with TTs (AAs: 1289 ± 141 kcal, TTs: 920 ± 112 kcal; $P < 0.05$), though there were no compensatory increases in appetite and food intake after exercise in either group ($P > 0.05$). Exercise elevated concentrations of peptide YY and glucagon-like peptide-1 ($P < 0.05$); however, no differences were seen between genotypes ($P > 0.05$).
Discussion
AAs exhibited higher postprandial appetite and energy intake than TTs, which is in accord with previous studies (Cecil et al., 2008; Karra et al., 2013). Suppression of acylated ghrelin during exercise was particularly strong in AA participants. The therapeutic potential of exercise in FTO rs9939609 A allele carries is worthy of further investigation.
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Contact
J.L.Dorling@lboro.ac.uk

ACUTE HORMONAL RESPONSE TO 3 DIFFERENT TYPES OF "CONCURRENT" TRAINING

CHUNG, L.H.1, MARIN-PAGAN, C.1, MARIN-CASCALES, E. 1, FREITAS, T.T.1, RUBIO-PEREZ, J.M.1, MARTINEZ-NOGUERA, F.J.1, CARLOS-VIVAS, J.1, GUADALUPE-GRAU, A.2, MONTORO-GARCIA, S.1, RUBIO-ARIAS, J.A.1
1. CATHOLIC UNIVERSITY OF MURCIA, 2. TECHNICAL UNIVERSITY OF MADRID

Introduction
The type of resistance exercise stimulus is an important mediating factor in acute hormonal responses (1). However, it is unclear if there is a temporal difference in hormonal response among the different training protocols designed to enhance concurrently neuromuscular and cardiovascular adaptations. Thus, the aim of this study was to examine the temporal acute hormonal responses following traditional concurrent training (CT), high-intensity resistance circuit training (HRC) and high-intensity interval training (HIIT).
Methods
Eleven recreationally-active males (24.5 ± 5.1 years) performed each of the 3 training protocols in a randomized order with 7 days of rest between training sessions. HRC consisted on a circuit-based training with active rest and CT, on traditional resistance training with passive rest. Both HRC and CT entailed 3 sets of 6 exercises (6RM) of the upper and lower body with 3 min of local recovery. In addition, CT contained 20 min of treadmill running at the second ventilatory threshold. For HIIT, participants performed 36 sprints of 20 m (2 blocks of 3 sets of 6 sprints/set; 15s rest between sprints; 3 min rest between sets). For each training method, there was 5 min of rest between blocks. Blood samples were taken at baseline, 20 min post-training session (P20m), post-1 hr (P1h), post-24 hrs (P24h) and post 48-hrs (P48h). The concentrations of testosterone (T), cortisol (C) and growth hormone (GH) were determined. Two-way rmANOVA was used to detect differences in training protocols and in time. Significance level was set at $P \leq 0.05$.
Results
T concentrations were higher in HRC compared with HIIT at P48h ($p=0.023$). C concentrations were higher in HIIT compared with HRC at P20m ($p=0.048$) and P1h ($p=0.05$). In the CT protocol, we observed a decrease in T concentrations ($p<0.001$), as well as an increase in GH levels ($p<0.001$) at P20m. In the HRC protocol, an increase in GH concentrations was observed at P20m ($p<0.001$). Finally, in the HIIT protocol, there was an increase in GH levels at P1hr ($p<0.001$).
Discussion

The present study shows a temporal difference in hormonal response between HRC and HIIT. There appears to be a greater anabolic response at P48h following HRC compared with HIIT, which corresponds with the fact that HRC is more strength based (2). However, HIIT appears to have a greater catabolic effect soon after the training session compared with HRC. The high-intensity protocols have greater acute GH response, which indicates that this type of training is a potent stimulus as reported by others (3).

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Contact
lhchung@ucam.edu

PITUITARY AND ADRENAL HORMONAL LEVELS CHANGE DURING 8 DAYS OF EXHAUSTIVE CYCLING BUT ARE UNRELATED TO PERFORMANCE DECREMENT

TEN HAAF, T.1, VAN STAVEREN, S.2, FOSTER, C.1,3, ROELANDS, B.4,5, MEEUSEN, R.4,6, PIACENTINI, M.F.4,7, DAANEN, H.A.M.1, DE KONING, J.J.1,3

1: VU (AMSTERDAM, NL), 2: UMCU (UTRECHT, NL), 3: UWLAX (LACROSSE, WISCONSIN, US), 4: VUB (BRUSSEL, BE), 5: FWO (BE), 6: JCU (QUEENSLAND, AU), 7: UNIROMA4 (ROME, IT)

Introduction
It has been suggested that changes within the pituitary and adrenal hormonal profile occur with exhaustive training and overreaching, since differences in adrenocorticotropic hormone (ACTH), growth hormone (GH), prolactin (PRL) and cortisol have been shown after training overload and in cross-sectional studies. Yet, data on the early alterations during intensified training is lacking. The goal of this study was to get insight in the hormonal changes during intensified training, and investigate if changes were related to changes in physical performance.
Methods
Thirty cyclists (mean±SD age 41±11 y, BMI 23.5±2.1 kg/m2 and VO2max 51.8±6.3 ml/kg/min) who participated in an 8-day cycling tour of 1,300 km with 18,500 climbing meters were included in this study. The external training load during the tour was approximately 900% relative to preparation. Morning and post-exercise serum and plasma samples were collected from the antecubital vein at the start, mid and end of the tour. Samples were analyzed for ACTH, GH, PRL and cortisol. Performance was measured before and after the tour by means of a maximal incremental cycle ergometer test. Subjects with a decrease in performance larger than the smallest worthwhile change (0.5% peak power output) were classified as functionally overreached (FOR), all others as acutely fatigued (AF). Mixed ANOVAs were used to test for effects of time (start, mid, end) and group (AF, FOR) on hormonal levels.
Results
One subject was excluded due to asthmatic symptoms during the exercise tests, 15 subjects were classified as FOR and 14 as AF. Morning ACTH ($p<.01$), cortisol ($p=.01$) and PRL ($p<.01$) were lower while GH ($p=.03$) was higher at the end compared to the start of the tour. In contrast, post-exercise cortisol ($p<.01$) and GH ($p<.01$) were higher at the end compared to the start of the tour. The ACTH:cortisol ratio was decreased both in the morning ($p<.01$) and post-exercise ($p<.01$). No differences between AF and FOR were observed for all measures.
Discussion
Pituitary and adrenal hormonal levels were generally decreased in the morning, whereas post-exercise levels increased during 8 days of intensified training. Yet, no differences between AF and FOR were found. This suggests that the observed changes in the pituitary and adrenal hormonal profile are a general response to intensified training, and that these hormones cannot be used for early distinction between AF and FOR.

Contact
tpg.ten.haaf@vu.nl

Oral presentations

OP-PM20 Interval training 2

EFFECT OF DIFFERENT SPRINT INTERVAL TRAINING WORK: REST RATIOS ON PERFORMANCE ADAPTATIONS

LLOYD JONES, M., JAKEMAN, J.

OXFORD BROOKES UNIVERSITY

Introduction
A growing body of research has considered sprint interval training (SIT) as a method for the enhancement of exercise performance, but the influence of the relationship between work and rest is not well understood. The purpose of the current study was to examine the influence of different work: rest ratios on repeated sprint exercise.
Methods
24 physically active men and women completed two weeks of SIT, comprising 10x6s cycling sprints against a load equivalent to 7.5% body mass, 3 times per week. Volunteers were randomly assigned to a work rest ratio of 1:8, 1:10 or 1:12 (all $n = 8$) such that between sprints, participants had 48s, 60s or 72s rest respectively. Peak power (PP), mean power (MP) and fatigue index (FI%) were calculated for each session, and compared over the two-week training period (presented as mean ± SD).
Results
SIT significantly increased PP after training, from 1062.0 (± 344.4) to 1125.9 (± 369.2) W, 1091.5 (± 282.0) to 1148.0 (± 285.5) W, and 1074.3 (± 196.0) to 1135.4 (± 207.6) W in the 1:8, 1:10 and 1:12 groups respectively ($p < 0.05$). MP also increased significantly from 907.8 (± 282.9) to 954.0 (± 289.3) W, 950.8 (± 229.6) to 991.6 (± 228.6) W and 948.5 (± 178.2) to 982.5 (± 178.9) W, in the 1:8, 1:10 and 1:12 groups respectively ($p < 0.05$). FI% also increased significantly throughout the training, from 19.2% during session 1, to 26.2% in session 6. There were no significant differences between groups for PP, MP, or FI%.
Discussion

This study indicates that repeated 6s sprints can improve measures of power output, and that these improvements occur regardless of work: rest ratio for short sprints, although increases in FI% may suggest that force maintenance characteristics are not affected in a similar way.

EFFECTS OF HIGH INTENSITY INTERVAL TRAINING IN CYCLING ON RUNNING PERFORMANCE IN ATHLETES

MALLOL SOLER, M.

FLINDERS UNIVERSITY & UNIVERSITY OF BASQUE COUNTRY

Introduction
HIIT and cross training may be an alternative to achieving time efficient and greater improvements in aerobic capacity (VO2 max) or endurance performance with a lower risk of injury (Millet et al., 2002; Mutton et al., 1993) This could be especially useful for triathletes who train in both cycling and running. The purpose of the present study was to investigate the effects on physiological and performance variables in triathletes after 4 weeks half volume reduced training, compensated with two cycling HIIT sessions per week.
Methods
Fourteen experienced athletes (7 females and 7 males) regularly competing in cycling, running or triathlon competitions were recruited and randomly allocated to (1) a HIIT group who reduced their training volume by half but replaced this with supervised HIIT cycling and (2) a control group who maintained their usual volume over the 4- week intervention. Before and after intervention program, athletes were submitted to different laboratory tests: (1) Anthropometric measures, (2) Cycle ergometer VO2max test to determine aerobic capacity and ventilator threshold (VT) and (3) Simulated triathlon (20km cycle + 5 km run).
Results
VO2max (ml.kg.min) significantly increased in the HIIT group (42.4 1.7 vs 45.2 1.9 p = 0.03 d = 1.55) but remained unchanged in the control group (43.1 2.0 vs 42.8 2.1 p =0.69 d= 0.14).Furthermore, the increase in VO2max in the HIIT group produced a significant interaction between both groups, showing a superior improvement in HIIT compared to the Control group F = 4.72 p = 0.05. Power at VT remained unchanged for Control group (192 35 vs 192 38 W p) whereas power at VT improved significantly in the HIIT athletes (178 41 vs 220 45 d =0.98 p= 0.12). No significant differences were observed in simulated triathlon between tests on HIIT group, however, control group decreased significantly the running performance time (28.9 4.0 minutes to 27.1 2.7 minutes d =0.68 p = 0.047).
Discussion
VO2max was significantly increased after 4-weeks of HIIT training which was in agreement with previous researchers who observed an enhance of the aerobic capacity after a HIIT training program (Etxebarria et al., 2014; Gojanovic et al., 2015). No changes in cycling and running performance were observed after cycling HIIT period, in contrast with Lindsay et al. (1989) and Mutton et al.(1993) who found an improvements on cycling and running performance, respectively. In conclusion, HIIT cycle training is a useful training method for maintaining running performance in triathletes, considering that different mechanisms influence endurance performance that can be targeted by different intensity and volume training stress.
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Contact
mall0078@flinders.edu.au

HIGH-INTENSITY INTERVAL TRAINING IN PHYSICAL EDUCATION

ENGEL, F., WAGNER, M.O., SPERLICH, B.

HEIDELBERG UNIVERSITY

Introduction
High-Intensity interval training (HIIT) has shown to enhance aerobic capacity in both trained (Sperlich et al. 2011) and untrained children (Baquet et al. 2002) involving less time/session compared to low intensity aerobic training (LOW). However, to date, the effects and applicability of HIIT performed during regular physical education has not been investigated. The aim of this study was to examine the short-term effects of a 6-week HIIT vs. LOW aerobic program (applied within physical education) in 11-year-old pupils on variables related to endurance, motor performance as well as mood and perceived exertion.
Methods
During the 6 week intervention, 85 pupils (34 male; 51 female; age: 11.2±0.9 yrs) performed 11 sessions of either HIIT (20 min, intervals from 10 s to 4 min at ≈90-100% of maximal running speed (vmax)) or LOW (30 min, intervals from 6-25 min at ≈65-85% of vmax). Before and after the 6-week intervention each pupils' anthropometry and motor performance (20-m sprint, standing long-jump, push-ups, sit-ups, 6-min run) was assessed. Session rating of perceived exertion (RPE) was recorded after each session (Foster et al. 2001) and mood was assessed by questionnaire (Wilhelm & Schoebi, 2007) following the 3rd, 6th, 9th and 11th session.
Results
RPE ($p<.05$; cohen's $d = .62$) and mood ($p<.05$; cohen's $d = .43$) was higher with HIIT compared to LOW. Performances in the 6-min run ($p<.001$; part. $\eta2 = .473$), 20-m sprint ($p<.001$; part. $\eta2 = .226$), standing long-jump ($p<.05$; part. $\eta2 = .056$), push-ups ($p<.001$; part. $\eta2 = .523$) and sit-ups ($p<.001$; part. $\eta2 = .146$) improved following HIIT and LOW with no significant time x group interaction (except for the sit-ups ($p<.05$; part. $\eta2 = .048$)).
Discussion
HIIT and LOW improved the performances in 6-min run, 20-m sprint, standing long-jump and push-ups similarly. However, the improvements in HIIT compared to LOW were achieved in 30 % less time. As time is limited in physical education, HIIT offers a new perspective for improving endurance and motor performance in children. The positive mood associated with HIIT demonstrates the applicability in physical education.
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Contact
florian.engel@issw.uni-heidelberg.de

DIFFERENT HIGH-INTENSITY SHOCK MICROCYCLES DO NOT AFFECT PERFORMANCE COMPONENTS IN PREPUBESCENT ELITE SOCCER PLAYERS

SLOPIANKA, M., KAPPENSTEIN, J., WIEWELHOVE, T., SCHAFFRAN, P., FERRAUTI, A.
RUHR-UNIVERSITY BOCHUM

Introduction
High-intensity training (HIT) has shown to be an appropriate method to enhance performance in young athletes (McManus et al., 2005; Engel & Sperlich, 2014). Especially children tolerate HIT exercises very well and may also benefit from specific training interventions like block periodization (Kappenstein et al., 2015). Therefore the aim of our study was to examine (Engel & Sperlich, 2014) acute responses of prepubescent elite soccer players to the training load of two different HIT shock microcycles and (Kappenstein et al., 2015) the effects of these on physical performance components.
Methods
17 soccer players (10.9 ± 0.6 years) took part in the intervention. The sample was divided in two training groups (TG240: n = 9, TG15: n = 8) according to the utilized HIT-protocol (4 x 4 min vs. 3 x 9 x 15 s). All participants performed 11 HIT and 10 soccer training sessions within eleven days. Training monitoring to determine acute responses included creatine kinase (CK) and salivary cortisol (sC). Pretest values in an incremental treadmill test, a shuttle run test and a sprint test were compared to posttest values after 2 (post I) and 21 (post II) days concerning peak oxygen uptake (O2peak), maximal heart rate (HRmax), maximum running speed (vIFT) and linear sprint performance (LS).
Results
CK activity was significantly elevated in all participants on day 2, 6, and 11 of training intervention compared to baseline. O2peak values were lower and LS times higher in post I compared to pretest. Significant performance improvements occurred in vIFT during post II. No significant differences between training groups were found.
Conclusion
The study evaluates that prepubescent elite soccer players are fatigued by the training load on the 6th day of the eleven-day HIT shock microcycle. Less performance in post I indicates that the length of two recovery days seems to be not sufficient time to recover from the previous training. Only vIFT could be improved by both HIT protocols in post II compared to baseline values. Further research is required to investigate the sustainability of block periodization and potential of HIT shock microcycles.
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EFFECT OF DIFFERENT TRAINING INTENSITIES ON PLASMA ESTIMATED VOLUME VARIATION AND ENDURANCE PERFORMANCE

RHIBI, F., BEN ABDERRAHMAN, A., BEN-ATTIA, M., PRIOUX, J.
, SPORT, AND HEALTH SCIENCES LABORATORY, UNIVERSITY OF RENNES2, FRANCE.

Introduction
In response to training, plasma volume (PV) variations are influenced by differences in intensities (Zouhal et al. 2009). Several studies have shown that a short training period involving intermittent exercises may result changes in PV. Little is known about the effects of training on PV and his link to the improvement of endurance aerobic fitness or performance. Thus, we aimed to compare the effect of different training program intensities on PV variation at rest and in response to intermittent exercise.
Methods
29 male volunteered have participated in this study. Subjects were assigned to control group (CG), trained group with 100% of maximal aerobic velocity (MAV) (EG100) and trained group with 110% MAV (EG110). Before and after 8-weeks training program, all participants performed a maximal graded test and an intermittent exercise test. Blood was collected at rest, immediately at the end of the intermittent exercise test and after 15min of passive recovery. Training sessions (3sessions/week) presented only short intermittent exercise (30/30).
Results
After training, MAV was more important in EG110 (+1.5%) than EG100 (+0.92%). Hb deceased significantly in EG100 and EG110 at rest, at the end of intermittent test and after 15 min of recovery. After training, Hb determined at rest was lower in EG100 (-0.6±0.2%) than EG110 (-0.3±0.1). We showed a significant decrease in Ht rate in EG100 and EG110 at rest, at the end of intermittent test and 15th min of rest after training. Ht rates values were more important in EG110 than EG100 at rest (-3.0±0.5 vs-1.3±0.7), at the end of exercise (-4.2±0.9 vs-2.1±1.2) and after 15min of recovery. PV increased, after training, in both trained groups. No difference was observed between training groups.
Discussion
Training program with 110% MAV induced better endurance performances with the same PV variations. Ht rates were lower in EG110 than EG100. This decrease is due to a disproportional increase of PV compared with the increase in red blood cells and is well known as sportsmen's anemia. After training, Hb decrease in both groups at rest and in response to intermittent exercise. Green et al. (1991) observed a decrease in Hb after training program using 62% MAV. However, Ben Abderrahman et al. (2012) did not showed any variation in Hb concentration and in PV variation after intermittent training.
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HIGH INTENSITY INTERVAL TRAINING DECREASES INFLAMMATORY CYTOKINES AND IMPROVES BONE TURNOVER MARKERS IN OBESE WOMEN

ATAKAN, M., OSALOU, M.A., GÜZEL, Y., TARTIBIAN, B., KOŞAR, Ş.N.

HACETTEPE UNIVERSITIY

Introduction

Although obesity has traditionally been considered a protective factor for bone health due to its mechanical loading effect, recent studies showed that obesity-induced chronic low grade inflammation may negatively affect bone metabolism (Cao, 2011; Mundy, 2007). Exercise training is known to decrease body fat percent and inflammatory cytokines, and improves bone turnover markers. However, data on the relation among obesity, inflammatory cytokines and bone health is very limited. Thus the purpose of this study was to evaluate the effect of high intensity interval training (HIIT) on inflammatory cytokines and bone turnover markers in obese women.

Methods

24 healthy, sedentary, obese women (Body mass index (BMI): 30- 34.99 kg/m2, age: 35.76±3.32 yrs.) were randomized into either Control (n=10) or HIIT (n=14) group. HIIT group participated in a 12-week, supervised HIIT program 25 min/day (4*4 min bouts, 3 min active rest between each), 3 days/week, at 85-95% of each subject's age-predicted maximal heart rate. Blood samples were drawn at baseline and after 12-week and assayed for interleukin-1 alpha (IL-1α), tumor necrosis factor alpha (TNF-α), C-reactive protein (CRP), bone alkaline phosphatase (BALP), C-terminal telopeptide cross-links of Type 1 collagen (CTX) and osteocalcin (OC).

Results

After HIIT intervention, BMI (5%), body fat percent (6%), TNF-α (%39), IL-1α (%15), CRP (14%) and CTX (14%) decreased ($p<0.05$); while VO2max (54%) and osteocalcin (23%) increased significantly ($p<0.05$). Increase in BALP (19%) was not statistically significant ($p>0.05$). In addition, changes in inflammatory cytokines (IL-1α, TNF-α, CRP) over 12 weeks was positively associated with the changes in bone resorption marker of CTX (r=0.82, 0.59, 0.53, respectively) and negatively associated with the changes in bone formation markers of osteocalcin (r=-0.59, -0.54, -0.29, respectively) and BALP (r=-0.47, -0.39, -0.64, respectively). All these associations were statistically significant except the correlations between CRP and OC, and between TNF-α, and BALP and CTX.

Discussion

Findings of the study indicated that 12 weeks of HIIT program was beneficial in improving cardiorespiratory fitness and body composition in obese women. Moreover, the HIIT program was effective in reducing inflammatory cytokines, improving bone formation and reducing bone resorption markers. Consequently, the results of this study suggest that HIIT is an effective way to improve both inflammatory state and bone health in obese women.

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Contact

Email address: muhammed.atakan@hacettepe.edu.tr

Oral presentations

OP-BN06 Fatigue

CAN NON-INVASIVELY DETERMINED MUSCLE TYPOLOGY PREDICT FATIGUE AND RECOVERY PROFILE?

LIEVENS, E., BEX, T., DERAVE, W.

GHENT UNIVERSITY

Introduction

It is well-known that human fast-twitch (FT) fibers are faster fatigued and require a longer recovery period, compared to slow-twitch (ST) fibers. The transfer of this knowledge to the recovery from exhaustive training and matches in athletes with a diverging muscle typology, is hampered by the invasive nature of the current evaluation of the muscle fiber type composition by biopsies. Recently, muscle carnosine quantification by proton magnetic resonance spectroscopy (1H-MRS) was developed as a new non-invasive estimation method (Baguet et al., 2011). The aim of this study was to investigate if subjects with predominantly FT fibers are characterized with a more pronounced Wingate-induced fatigue and delayed recovery compared to the ones with predominantly ST fibers.

Methods

21 male potential participants were scanned by 1H-MRS according to Baguet et al. (2011) and were included if their gastrocnemius muscle carnosine concentration was <0.5 (ST) or >0.5 (FT) Z-score compared to the reference population. So far, 6 subjects with mainly FT (VO2max: 4.0±0.6 L/min) and 6 subjects with mainly ST typology (VO2max: 4.3±0.2 L/min) underwent the test protocol, consisting of three 30" all-out Wingate tests on a Cyclus ergometer, interspersed with 4 min of rest. Before and 10, 20, 30, 50, 80, 120, 160 and 300 min after the repeated Wingates, knee extension force was evaluated by isometric maximal voluntary contraction (MVC) and electrical femoral nerve stimulation (100Hz, 10Hz, and twitch; Digitimer, DS7A) and capillary blood samples were taken for lactate, pH and HCO3- determination. The study group will be further expanded before the congress towards adequate statistical power, so only % differences are currently reported.

Results

Subjects with FT typology had larger disturbances and slower recovery of blood parameters compared to ST subjects. Although both groups performed the same mean power across all Wingates, the fatigue index (FI) within each Wingate and across Wingate tests was higher in FT (FI within 3 Wingates: 51±5%; FI across 3 Wingates: 18±10%) versus ST subjects (36±5% and 7±6%, respectively). For MVC, 20 min after the Wingates, the % of initial force was 94±8% in ST and 75±9% in FT, and even after 2 hours a difference of 11% in recovery could be found between both groups. Similar findings were observed for electrically-stimulated knee extension force.

Discussion

Our findings suggest that MR-based non-invasive estimation of muscle fiber type composition can predict the extent of fatigue and the time profile of force recovery following repeated maximal all-out exercise. This may have important applications as a non-invasive tool for individualizing advice for muscle recovery from intensive training in sports.

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Contact
elilieve.lievens@ugent.be

MAINTAINED FIRING OF GROUP III/IV MUSCLE AFFERENTS INHIBITS THE RECOVERY OF QUADRICEPS MOTONEURONE EXCITABILITY AFTER A SUSTAINED CONTRACTION

FINN, H.1,2, NUZZO, J.1,2, KENNEDY, D.3, GREEN, S.4, TAYLOR, J.1,2

1:NEUROSCIENCE RESEARCH AUSTRALIA, SYDNEY, AUSTRALIA. 2:UNIVERSITY OF NEW SOUTH WALES, SYDNEY, AUSTRALIA. 3:UNIVERSITY OF SYDNEY, AUSTRALIA. 4:WESTERN SYDNEY UNIVERSITY, SYDNEY, AUSTRALIA.

Introduction
In a fatiguing sustained contraction, quadriceps motoneurone excitability decreases greatly (Finn et al., 2016). Group III/IV muscle afferents could contribute to this effect through inhibition of the motoneurones. These afferents respond to mechanical and metabolic disturbances during exercise and when their firing is maintained by post-exercise occlusion of muscle blood flow, firing rates of quadriceps motoneurones decrease (Woods et al., 1987). We used post-exercise occlusion to determine whether firing of group III/IV muscle afferents decreases quadriceps motoneurone excitability.
Methods
On 2 separate days, 9 participants performed a 3-min sustained 40% max isometric knee extension contraction followed by a 2-min period with or without post exercise occlusion produced by a cuff inflated around the exercising leg. In the 2-min with or without occlusion, vastus medalis (VM) thoracic motor evoked potentials (TMEPs) were elicited during 5 brief 25% max contractions and recorded via surface electromyogram (EMG). TMEPs were evoked during the EMG silent period that follows transcranial magnetic stimulation (TMS) over the motor cortex (TMS-TMEP). TMS-TMEPs were also assessed at baseline. Effort to perform contractions was reported on an 11-point scale throughout. The 5 post-exercise TMS-TMEPs with and without occlusion were compared via a two-way ANOVA (time X day).
Results
After the 3-min contraction on both days, the grouped VM TMS-TMEP was reduced to 23±24% (mean±SD; $p<0.001$) of baseline. With occlusion, the TMS-TMEP did not recover and at 2 min post exercise was 19±23% of baseline, while without occlusion the TMS-TMEP increased to 40±35% of baseline. ANOVA showed a significant interaction ($F(4,32)=3.37$; $p=0.021$). Participants rated effort 3±1.8 points higher during contractions with occlusion ($p<0.001$).
Discussion
TMEPs elicited during pauses in descending drive (produced by TMS) decreased with fatigue and remained depressed with maintained group III/IV muscle afferent feedback. Thus, we show for the first time that in the quadriceps, fatigue-sensitive afferents act to inhibit motoneurones. The higher effort for contractions during post-exercise occlusion suggests that additional voluntary drive was required to compensate for the inhibitory feedback to the motoneurones.

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Contact
h.finn@neura.edu.au

PERIPHERAL FATIGUE RECOVERS FASTER IN SHERPA THAN LOWLANDERS AT HIGH-ALTITUDE

RUGGIERO, L., HOILAND, R.L., HANSEN, A.B., AINSLIE, P.N., MCNEIL, C.J.

UBC (KELOWNA, BC, CANADA)

Introduction
High-altitude represents a physiological challenge for the human body. The reduction in oxygen availability with ascent is associated with an exacerbation of muscle fatigue, compromising the ability of lowlanders (LL) to sustain physical activity. Sherpa (SH) have lived at altitude for generations and represent the gold-standard of adaptability to hypoxia. Our study aimed to compare muscular fatigability of LL and SH at 5050m (Everest-Pyramid Lab) after the same gradual ascent over 9 days. Before ascending, SH were de-acclimatized for 5-15 days at 1400m (Kathmandu, Nepal).
Methods
In 12 LL and 10 SH, fatigue was induced by 3 bouts of 75 electrically-evoked contractions of the quadriceps of the dominant leg. The trains of stimuli (12 pulses at 15Hz, 800ms rest between trains; 15s rest between bouts) were applied to the muscle bellies at the intensity which initially evoked 30% of maximal voluntary torque. At minutes 1, 2, 3, and 5 after the fatigue protocol (R1, R2, R3, and R5, respectively), a single train was delivered. A near-infrared spectroscopy sensor secured over rectus femoris continuously measured tissue oxygenation index (TOI) and total haemoglobin (tHb), whereas ultrasonography was used to record femoral artery blood flow (FABF) prior to fatigue, between bouts, and during recovery.
Results
Prior to fatigue, rate of force relaxation (RFR) was faster and TOI was higher in LL than SH (-158.6±30.4 vs. -119.0±44.8kg/s, and 69.3±4.4 vs. 63.6±5.5%, respectively) but rate of force development (RFD) and FABF were not different. At the end of bout three, peak force (PF), RFD, and RFR decreased, with no differences between groups (pooled data: PF: -35.8±7.6%; RFD: -38.6±16.9%; RFR: -47.85±16.9%). Likewise, TOI decreased, while tHb and FABF increased, with no differences between groups (pooled data: TOI: -12.0±7.0%; tHb: +6.2±5.0%; FABF: +1097.6±579.1%). Recovery of all measures were similar between groups, with the exception of RFD and RFR, which showed greater recovery in SH than LL by R2 and R1 (RFD: 92.8±23.1 vs. 68.7±22.0% baseline; RFR: 79.7±12.0 vs. 56.5±21.7% baseline).
Discussion
The similar alterations in force, contractile properties, blood flow and oxygenation data in LL and SH indicate that a lifetime of acclimatization does not impact acute peripheral fatigue at high-altitude. However, the faster recovery of RFD and RFR in SH compared to LL suggest that mechanisms of muscular contraction linked to force development and relaxation (e.g. calcium kinetics) might recover faster from

muscular effort in SH than LL. This might be beneficial when repeated effort is required and contribute to the superior performance of Sherpa at altitude.

EFFECTS OF TRAINING ON NEUROMUSCULAR FATIGUE IN CYCLING

MIRA, J.1,2, ABOODARDA, S.1, FLOREANI, M.1, JASWAL, R.1, MOON, S.1, AMERY, K.1, RUPP, T.2, MILLET, G.1
1: UOFC (CALGARY, CANADA), 2: USMB (CHAMBÉRY, FRANCE)

Introduction
Neuromuscular fatigue during and after cycling exercise is poorly understood due to the time required to move subjects from the cycle-ergometer to the isometric chair for neuromuscular function (NMF) assessment. Since NMF quickly recovers within the first 2 min after exercise, previous literature may have significantly underestimated exercise-induced fatigue. In addition, no study has ever investigated the effects of cycling training on fatigue. This study investigates the effects of short-term cycling training on fatigue development and etiology.
Methods
Fourteen healthy males underwent 8 weeks of cycling training comprising 3 weekly sessions of either high intensity interval training (HIIT) or constant-load cycling. One testing session was performed pre-training (PRE) and 2 testing sessions were randomly performed after training: one based on PRE VO2max (POST ABS) and one based on VO2max post-training (POST REL). The testing sessions, which consisted of an incremental test to exhaustion starting at 55% of VO2max, were done on a new cycle-ergometer with instrumented pedals developed in our lab, which allows NMF evaluation in isometric mode within 1-s. The NMF evaluation assessed before, during and immediately after the testing sessions comprised force recordings and electrical stimulation to assess maximum voluntary contraction (MVC) and peripheral fatigue (high-frequency doublet, Db100; Twitch, Tw). Statistical analysis was performed on data from baseline (before testing sessions), at exhaustion (EXH) in the 3 sessions, and as 100% of time to EXH of PRE.
Results
Time to EXH was significantly longer in POST ABS than PRE (34±5 vs 27±3 min, respectively, $P<0.001$), with no differences between PRE and POST REL (29±6 min). At EXH, MVC was significantly but similarly reduced to 58-64% of baseline in the 3 sessions. Likewise, significant reductions were seen in Db100 and Tw at EXH (52-60% and 48-54% of baseline, respectively), but to a similar extent amongst sessions. However, at 100% of time to EXH of PRE, MVC decreased more in PRE than in POST ABS (58±14 vs 73±13% of baseline, respectively, $P<0.001$) and POST REL (66±15% of baseline, $P=0.018$). Additionally, at 100% of time to EXH of PRE, Db100 was more depressed in PRE than in POST ABS (52±16 vs 71±8% of baseline, respectively, $P<0.001$), while Tw showed a greater decrease in PRE than in POST ABS (48±17% vs 62±11% of baseline, respectively, $P<0.001$).
Discussion
After 8 weeks of cycling training, neuromuscular fatigue is reduced as evidenced by the lower force drop and peripheral fatigue at 100% of time to EXH of PRE. Nonetheless, the same magnitude of fatigue observed at EXH in the 3 sessions indicates that fatigue tolerance may not be upregulated as a result of training.

NON-LOCAL MUSCLE FATIGUE IS MEDIATED AT SPINAL AND SUPRASPINAL LEVELS

AMIRI, E., GHARAKHANLOU, R., RAJABI, H., GIBOIN, L.S.
RAZI UNIVERSITY OF KERMANSHAH

Introduction
Effects of muscle fatigue are not restricted to the working muscles and can also affect remote muscles (Kennedy et al, 2013). The term "non-local muscle fatigue (NLMF)" has recently been coined to describe this aspect of fatigue; however, its underlying mechanisms are not fully understood (Halperin et al, 2015). Furthermore, while isotonic submaximal contractions are the most common type of action in many sports, maximal isometric contractions have been the most frequently used fatiguing protocol in previous studies. Since submaximal and maximal contractions may induce fatigue through different mechanisms (Taylor et al., 2008), the effect of submaximal contractions on NLMF is not known. Hence, the objective of the present study was to investigate the effect of unilateral isotonic fatiguing submaximal contractions done with the right Biceps Brachii muscle (BB) on the corticospinal excitability and motoneuron responsiveness of the contralateral BB and Abductor Digiti Minimi muscles (ADM).
Methods
Through 6 experimental sessions, motor evoked potential (MEP), cervical motor evoked potential (cMEP) and Mmax of the right BB, the left BB and ADM were measured before, during (only for the right BB), immediately after and 10 and 20 min after a fatiguing protocol performed by the right BB in 10 young adults. The fatiguing protocol consisted of 3 sets of 3 min elbow flexion and extension (1 min rest) at 25% of 1RM.
Results
MEP amplitude decreased in the right BB after the sets 2 and 3, while cMEP amplitude decreased after all the 3 sets. In the left BB, MEP amplitude declined up to 10 min after the fatiguing task, whilst cMEP amplitude decreased only after the fatiguing task. In the left ADM, MEP amplitude also declined after the end of the task, but no changes were seen in cMEP amplitude.
Discussion
These results indicate that in submaximal fatiguing contractions, decreased corticospinal excitability and motoneuron responsiveness can contribute to performance reduction. Moreover, we demonstrated that submaximal fatiguing contractions could induce NLMF, probably through corticospinal and spinal mechanisms.
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Contact
eamiri.tmu@gmail.com

INSIGHTS INTO MUSCLE EXCITABILITY DURING MAXIMAL VOLUNTARY CONTRACTIONS BY A SEPARATE ANALYSIS OF THE FIRST AND SECOND M-WAVE PHASES

RODRIGUEZ-FALCES, J., PLACE, N.

PUBLIC UNIVERSITY OF NAVARRA

Introduction
This study was undertaken to examine the changes in muscle membrane excitability during and after a 3-min sustained maximal voluntary contraction (MVCs) by assessing separately the changes in the first and second phases of the muscle compound action potential (M wave).
Methods
During the 3–min sustained isometric MVC, M waves from vastus lateralis, vastus medialis and rectus femoris muscles were evoked by supramaximal single electrical stimulation to the femoral nerve at 10-s intervals. During the 30-min recovery period, M waves were evoked during brief MVCs. The amplitude, duration, and area of the M-wave first and second phases, together with muscle conduction velocity and force were measured.
Results
During the 3-min MVC, the amplitude of the first phase increased progressively for the first minute (+33-43%, $p<0.05$) and then it remained stable for the rest of the contraction, whereas the second phase initially increased for 25-35s when it reached a peak (+30-50%, $p<0.05$), after which it decreased for the subsequent minute, before being stabilized for the rest of the contraction. After exercise, the amplitude of the M-wave first phase showed a decreasing trend, returning to pre-fatigue values ($p>0.05$) within 5-10 min, whilst the second phase increased progressively and remained higher than control (7-20%, $p<0.05$) after the 30-min recovery period. The enlargement of the first phase occurred in parallel with a decline in conduction velocity, and an increase in voluntary force (maximal cross-correlations, 0.9-0.93; time lag, 0s). Conversely, there was no temporal association between the second phase amplitude and conduction velocity or voluntary force.
Discussion
The present findings show that the enlargement of the M-wave first phase is the result of a decreased membrane excitability, probably brought about by the accumulation of extracellular K+. The results provide further support to the idea that only the amplitude of the M-wave first phase, but not that of the second phase or the peak-to-peak amplitude, can be used reliably to monitor possible changes in muscle membrane excitability.

Oral presentations

OP-BN10 Biomechanics: Gait

MOTOR CONTROL OF WALKING FORWARDS AND BACKWARDS ACROSS DIFFERENT INCLINES

ANGELOUDIS, K., MILLER, S.C.

LONDON SPORT INSTITUTE, MIDDLESEX UNIVERSITY

Introduction
Studies regarding human motor behaviour have considered that the variability of mechanical characteristics of human movement is not noise. Instead, this has been identified as indicative of true movement, and the functionality of this is considered highly valuable (Daffertshofer et al., 2004). The purpose of this study was to identify whether forward walking (FW) and backward walking (BW) affects the neural and kinematic mechanisms of lower limbs.
Methods
Fifteen subjects (11 M and 4 F; 26 yrs, 1.73 m, 68 kg) walked forwards and backwards on a treadmill (4 km.hr-1) at four different inclines (-5, 0, 5 and 10%). A 7-segment kinematic model of the lower limbs and pelvis was measured using a 21-camera 3D motion analysis system (500 Hz; Qualisys Opus 300+). Activation of seven muscles of the right leg were recorded (1000 Hz; Delsys Trigno). Primary analysis of complexity of variability of the kinematic motion and neural control was assessed using Principal Component Analysis (PCA). A 95% threshold was used to determine the number of components to retain. Further analysis was performed through examination of the individual waveforms to aid understanding of the primary analysis.
Results
The complexity of the movement pattern during FW appears more varied (4 components) than during BW (3 components) across all inclines. However, the complexity of the neural control appears similar across inclines and directions (4 components). Despite this similarity in overall complexity of neural control, the muscles associated with each component were different during FW and BW. During FW, the gastrocnemius medialis (GM) and gastrocnemius lateralis (GL) muscles were acting synergistically (i.e. during stance and push-off), whereas during BW the GM had two activation peaks, with the GL only having one. The second activation of the GM during BW coincided with the biceps femoris. This suggests that during FW, both the GM and GL act as plantarflexes, whilst during BW, the GM also acts as a knee flexor.
Discussion
Despite similarities in neural complexity of walking forwards and backwards, there are differences in complexities of the resultant movement patterns. This may be due to bi-articular muscles working across both joints in BW, but not FW. As such, these would be activated at different timings (ie plantarflexion and knee flexion for the GM) but the resultant joint actions would be similar. This may suggest that there is an extremely complex control strategy employed due to the numerous pairings of uni- and bi-articulators as well as agonist and antagonist pairings. In conclusion, despite this novel understanding, it suggests an even more complex underlying strategy associated with motor control.
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WALKING AND POLE WALKING AT DIFFERENT SPEEDS: ANALYSIS OF MOVEMENT PATTERN AND COMPLEXITY

ZOFFOLI, L., LUCERTINI, F., FEDERICI, A., DITROILO, M.
UNIVERSITY OF URBINO CARLO BO

Introduction
Pole walking (PW) is a walking-like physical activity that has increased in popularity in recent years. Compared to ordinary walking (OW) PW has been associated to additional trunk muscle coactivation (Zoffoli et al., 2016). However, there is a paucity of research on how the use of poles may influence the shape and complexity of the walking pattern and thus the stress induced to the body by the poles during walking. Accordingly, this study compared the shape and complexity of the OW and PW movement patterns at different speeds.
Methods
Two accelerometers were secured at C7 and S2 level on 20 healthy adults prior to performing a W and a PW bout of 1 minute at 60% and 100% of the walk-to-run preferred transition speed (PTS-60 and PTS-100, respectively). The anterior-posterior (AP), medial-lateral (ML) and vertical (VT) accelerations (ACC) of 30 strides per trial were analyzed. Movement complexity (ENT) was evaluated in each direction by the fuzzyEn algorithm. The effects of walking style (OW or PW) and speed (PTS-60 or PTS-100) on ENT and shape of the ACC patterns were investigated for the AP, ML and VT directions at both C7 and S2 level using a zero- and a one-dimensional 2-way repeated measures ANOVA (Pataky et al., 2015), respectively. Similarly, zero- and one-dimensional paired t-tests were used for posthoc comparisons. The alpha level of significance was set at 0.05 with Bonferroni corrected p-values for the multiple tests.
Results
Compared to the lower speed, walking and pole walking at the higher speed increased ENT in all directions and acceleration amplitude in the AP and VT directions, at both C7 and S2 level. At C7 level only, but for the majority of the phases of the stride, PW increased ENT significantly more than OW in all directions at both speeds. At C7 level, PW also resulted in greater acceleration amplitudes than OW, particularly during the mid-stance phase of the stride (VT direction), and in higher deceleration peaks at the toe-off (both AP and VT directions).
Discussion
Compared to OW, the increased ACC (AP and VT directions) at C7 level found during PW suggests that the use of poles requires greater upper trunk oscillation. PW is also associated to higher movement complexity over OW, possibly because of the increased arm engagement. In conclusion, an increased level of trunk muscle coactivation during PW may be required to contrast the higher upper-trunk ACC and ENT.
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INDIVIDUAL GAIT PATTERNS IDENTIFIED WITHIN A LONG-TERM FOLLOW-UP STUDY

HORST, F., MILDNER, M., SCHÖLLHORN, W.I.
JOHANNES GUTENBERG UNIVERSITY MAINZ

Introduction
Despite the common knowledge about the individual character of human movements, inter-individual differences in gait patterns are often neglected in biomechanical analysis and therapeutic interventions, as they are rather oriented on the idea of average behaviour and normality. Previous studies could distinguish gait patterns from individuals and emphasize the relevance of individualized diagnoses and therapy (Schöllhorn et al., 2002). However, small sample sizes are a limitation in the field of probabilistic subject identification on the basis of gait patterns and little is known about the persistence of subject-specific characteristics over time. The aim of this study was (1) quantifying the distinction of gait patterns from individuals within a larger sample and (2) quantifying the long-term (7-16 month) persistence of individual gait patterns.
Methods
A sample of 128 healthy participants (52 female, 76 male; M age: 23.8 years, SD 9.1) walked 10 times a distance of 10 m. Two force plates (Kistler, 1000 Hz) recorded the three-dimensional ground reaction forces during a double step at a self-selected walking speed under barefoot conditions. A subsample of 46 subjects repeated this procedure after 7-16 months. Firstly, the data from 128 subjects who participated in the first assessment session was classified by means of support vector machines (subject-classification). Secondly, the data from 46 subjects who participated in both assessment sessions was classified in order to quantify the persistence of individual gait patterns (subject-follow up-classification). The classification rates were calculated by means of the Liblinear Toolbox 1.4 (Fan et al., 2008) using a leave-one-out cross-validation.
Results
The application of support vector machines resulted in a classification rate of 99.8% (1278 out of 1280) and 99.4% (914 out of 920) for the subject-classification and the subject-follow up-classification, respectively.
Discussion
The present study pointed out that gait patterns based on time-continuous three-dimensional ground reaction forces were unique for an individual and could be differentiated from those of other individuals. Within a sample of 128 subjects, support vector machines classified gait patterns almost error-free to the corresponding individual. Hence, human gait is not only somehow different between individuals, but rather exhibits unique characteristics for an individual that are persistent over months or years. Our findings provide evidence for the clearly individual nature of human walking and emphasize the demand to evaluate clinical approaches for diagnoses and therapy that are based on individual needs.
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Contact
horst@uni-mainz.de

BIOMECHANICAL EVALUATION OF WALKING AND CYCLING IN CHILDREN

GRECA, J.P.A.1,2, RYAN, J.1, BALTZOPOULOS, B.3, KORFF, T.1

1: BRUNEL UNIVERSITY LONDON (UXBRIDGE, UNITED KINGDOM), 2: CAPES FOUNDATION, MINISTRY OF EDUCATION OF BRAZIL (BRASÍLIA, BRAZIL), 3: LIVERPOOL JOHN MOORES UNIVERSITY (LIVERPOOL, UNITED KINGDOM)

Introduction
Overweight and obese children may be at a high risk for injuries of the lower limb joints. Thus, attention is needed when prescribing physical activity programmes for this population. Walking has been recommended for this population. Whilst walking has been proven to result in physiological benefits, it is a weight bearing activity and has the potential to induce high joint loading, which could lead to pain and thereby create a barrier to physical activity. One solution could be the prescription of a non-weight bearing activity of similar physiological intensity. Cycling is such an activity and is also appealing to children. Therefore, the purpose of this study was to compare joint loading between walking and cycling in children.
Methods
With institutional ethical approval, 17 pre-pubertal children aged 8-12 walked on an instrumented treadmill and cycled on a stationary ergometer. Two methods were used to match physiological intensity. First, cardiovascular loads between walking and cycling were matched using heart rate. Second, metabolic load was normalised by matching oxygen consumption (American College of Sports Medicine). Joint reaction forces during cycling and walking as well as joint moments were derived using inverse dynamics.
Results
Compressive peak forces were greater on the knees (N/kg = -11.9, SD = 1.8) and ankles (N/kg = -12.7, SD = 1.7) during walking than during cycling (N/kg = -3.3, SD = 1.0 and N/kg = -3.9, SD = 1.0; P<.001). Shear peak forces at the knee (N/kg = 1.1, SD = 0.4) and ankle (N/kg = 1.6, SD = 0.3) were also significantly larger during walking than during cycling (N/kg = 0.6, SD = 0.3 and N/kg = 0.8, SD = 0.3; P<.001), independent of how physiological intensity was normalised. For both cycling conditions, ankle moments (Nm/kg = 0.4, SD = 0.1 and Nm/kg = 0.3, SD = 0.1) were significantly smaller during cycling than walking (Nm/kg = 1.1, SD = 0.2; P<0.01). No differences were found for knee moments.
Discussion
At equivalent intensities, cycling results in less joint loading than walking. It can be speculated that the prescription of cycling for obese children may result in less joint pain and thereby reduce barriers to physical activity. This in turn could have implications for physical activity and weight management programmes. Our results provide a useful basis for future research to assess these speculative links explicitly in overweight and obese children.
Contact
Joao.DeAguiarGreca@brunel.ac.uk

EFFECTS OF TRACKING LANDMARKS AND TIBIAL POINT OF FORCE APPLICATION ON THE ASSESSMENT OF PATELLAR TENDON MECHANICAL PROPERTIES IN VIVO

MERSMANN, F.1, SEYNNES, O.R.2, LEGERLOTZ, K.1, ARAMPATZIS, A.1

1: HU BERLIN, GERMANY; 2: NSSS, NORWAY

Introduction
Different approaches exist for measuring patellar tendon elongation with ultrasound (US), a primary measure in the assessment of its mechanical properties in vivo. The present study investigated the effects of tracking either the tibial tuberosity (T; commonly used with long US transducers) or plateau (P, short transducers) in the US analysis and its interaction with the tibial point of force application in a dynamometer setting.
Methods
Nineteen adults performed isometric contractions with the shank pad positioned at 60% (p60) or 80% (p80) of tibia length (proximal to distal), respectively. Knee joint moments were calculated using an inverse dynamics approach. Tendon elongation was measured using the caudal pole of the patella and either T or P and evaluated in 100 N intervals.
Results
Knee joint rotation and the change of the angle between the tendon and the anterior intercondylar area of the tibia was significantly greater at p60 compared to p80 ($p<0.05$). A repeated measures ANOVA indicated a significant effect of tracking landmark on the measured tendon elongation at all force levels from 100 N to TFmax ($p<0.05$) and interaction with the pad position at TFmax ($p<0.05$), with greater elongations measured when using P for tracking and increasing differences between landmarks at p60 (T: p60 3.2±1.2 mm, p80 3.4±0.9 mm; P: p60 4.2±1.4 mm, p80 3.8±1.2 mm), while there was no main effect of pad position. The first derivative of the force-elongation curve showed significantly higher values for T until 60% of TFmax ($p<0.05$). At higher force levels, the differences in the first derivative were not significant and there was no significant effect of landmark or pad position when using the average value between 50% and TFmax for calculating stiffness. The agreement between T and P for stiffness was acceptable at p80 (limits of agreement of 249 to -308 N/mm), but poor at p60 (704 to -558 N/mm).
Discussion
The present study demonstrated that the choice of tracking landmark clearly affects the assessment of the force-elongation curve of the patellar tendon. This effect is most evident at a proximal point of force application, likely due to greater sagittal tibia rotation, which introduces a positive bias on the elongation measurement when using the tibia plateau and not the insertion as landmark. However, when using a distal point of force application and calculating the average derivative of the force-elongation curve between 50% and TFmax (i.e. commonly used for tendon stiffness calculation), there seems to be an acceptable agreement between landmarks. These findings have important implications for the assessment of tendon properties in vivo and cross-study comparisons.
Contact
falk.mersmann@hu-berlin.de

Invited symposia

IS-BN09 MODALITIES OF INTERPERSONAL COORDINATION

AVAILABILITY OF SHARED VISUAL INFORMATION IN SOCIAL INTERACTION

VESPER, C.

CENTRAL EUROPEAN UNIVERSITY BUDAPEST

Visual information about another person's action provides many cues that can be used to predict the unfolding of this action (Aglioti et al., 2008; Sartori et al., 2011). For example, observing someone running gives away the direction of running and looking at someone lifting an object allows an estimate of how heavy the object must be. But how is perceptual information used in a jointly performed task in which two or more people coordinate in order to achieve a common goal (Sebanz et al., 2006)? In contrast to pure observation cases, acting with others requires close coordination in space and time and co-actors often need to adapt to each other's actions within seconds or even milliseconds to ensure smooth performance as when passing a basketball to a team member while making sure the opponent does not get in the way. Information derived visually from one's interaction partner is a useful tool for establishing such interpersonal coordination.

I will discuss how the presence or absence of shared visual information, i.e. of online visual feedback about a co-actor's actions, influences the way jointly performed actions are approached (Vesper et al., 2016). Specifically, I will present data from motion tracking experiments that demonstrate, first, how co-actors actively enhance the availability of visual cues to support prediction processes for the partner (Vesper and Richardson, 2014) and, second, how in the absence of visual information, knowledge about a co-actor's specific task allows predictions, thereby compensating for the missing online feedback (Vesper et al., 2013).

Both processes are closely linked to internal action simulation in the motor system (Jeannerod, 2004; Wolpert et al., 2003).

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Contact

vesperc@ceu.edu

AUDITORY INFORMATION MODULATES INTERPERSONAL COORDINATION

SCHMITZ, G., EFFENBERG, A.O.

UNIVERSITY OF HANNOVER

Introduction

The mechanisms of social interactions and interpersonal coordination have traditionally been described by representation-oriented approaches and the mentalizing of a partner's intentions and beliefs. But it is also hypothesized that interpersonal coordination depends on basic sensorimotor interaction patterns (DiPaolo & De Jaegher, 2012). In this talk, we will refer to results of the project "socializing SensoriMotor Contingencies" (EU H2020 FETPROACT).

Methods

Empirical findings on the impact of additional auditory feedback on joint performance will be presented. It will be distinguished between different informational conditions and several grades of interaction.

Results

Data show an influence of auditory information on the mode of interaction. Depending on the auditory information provided, movements are temporally aligned / misaligned and movement rhythms change.

Discussion

This project provides insight into basic mechanisms of interpersonal coordination and how they can be addressed by movement information in different perceptual modalities. Here it is particularly shown that via movement sonification a common percept for all interaction partners can be established, which corresponds well to the concept of intercorporeality. Transferring these findings to the field of team rowing a significant effect on team performance seems to be expectable.

References

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INDIVIDUAL DIFFERENCES IN TEMPORAL ANTICIPATION AND ADAPTATION DURING REAL-TIME INTERPERSONAL COORDINATION IN JOINT DRUMMING

KELLER, P.

WESTERN SYDNEY UNIVERSITY

Musical ensemble performance showcases the remarkable human ability to coordinate movements with rhythms produced by other individuals. Such interpersonal coordination requires co-performers to anticipate and adapt to each other's action timing. While temporal anticipation and adaptation are grounded in fundamental sensory-motor mechanisms, the capacity for precise interpersonal coordination is nevertheless characterized by individual differences. I will present the results of studies that investigated these individual differences in joint drumming tasks requiring paired participants to synchronize with one another under conditions of varying difficulty (constant vs. variable tempo) and leadership (leader assigned vs. not assigned). The sources of observed differences in interpersonal coordination skill are examined using a computational model that quantifies the degree to which each individual engages in temporal anticipation and adaptation. Correlations between these individual differences and aspects of personality are informative about links between basic sensory-motor mechanisms and social-cognitive processes supporting real-time interpersonal coordination. These links may

constrain performance in team sports where cooperative and competitive processes rely on the coordination of one's own rhythmic movements with those of others either concurrently or via turn taking.

Invited symposia

IS-SH02 Stress regulation and physical activity

CARDIORESPIRATORY FITNESS MODERATES THE RELATIONSHIP BETWEEN PERCEIVED STRESS AND CARDIOVASCULAR RISK FACTORS

GERBER, M., BÖRJESSON, M., LJUNG, T., LINDWALL, M., JONSDOTTIR, I.H.

UNIVERSITY OF BASEL

Introduction
Cardiovascular diseases (CVD) are the most frequent cause of mortality in developed countries, and psychosocial stress plays an important part in the development of CVD. Because cardiorespiratory fitness (CRF) has been associated with decreased CVD and mortality, this study examines how CRF and perceived stress are associated with eight cardiometabolic risk factors, and if participants' CRF levels moderate the relationship between stress and cardiometabolic risk.
Methods
197 participants (51% men, Mage=39.2 years) performed the Åstrand bicycle test. Systolic (SBP) and diastolic blood pressure (DBP), body mass index (BMI), total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), triglycerides (TG), and glycated hemoglobin (HbA1c) were assessed as indicators of cardiometabolic risk.
Results
Higher LDL-C and TG existed in participants with elevated stress scores. Lower SBP, DBP, BMI, LDL-C and TG were observed in participants with high CRF. Participants with elevated stress who also had high CRF had lower SBP, DBP, LDL-C, and TG than participants with elevated stress, but low or moderate CRF.
Discussion
Better CRF is associated with decreased cardiometabolic risk, particularly if participants are exposed to high stress. Measuring CRF can help motivating people to adopt a more physically active lifestyle and provide some protection against the health hazards associated with chronic stress.

DOES PHYSICAL ACTIVITY MODERATE THE STRESS-BURNOUT RELATIONSHIP?

ISOARD-GAUTHEUR, S., GINOUX, C., SARRAZIN, P.

UNIVERSITÉ GRENOBLE ALPES

Introduction
The literature states that job burnout (JBO) is the result of persistent stress. In order to identify factors that could potentially limit the occurrence of JBO it is relevant to examine moderators of the stress-JBO relationship. Physical activity (PA) could be effective in improving health and preventing JBO (Gerber et al., 2013). This study aims to examine the moderating effect of PA on the stress-JBO relationship.
Methods
University staff members (N = 297; 68.01% females; Mage = 43; Myears of experience = 12.58; MIMC = 23.39) participated in this online study and completed the Saltin-Grimby PA Level Scale; the Shirom-Melamed BO Measure; and the Perceived Stress Scale.
Results
Multiple regression analyses with moderation revealed that physical activity significantly moderates (β=.42; p=.02) the stress-emotional exhaustion relationship (r=.13*); and tends to moderate (β=.30; p=.08) the stress-physical fatigue relationship (r=.25***); and also tends to moderate (β=.21; p=.10) the stress-global burnout relationship (r=.19**).
Discussion
Stress was positively linked to JBO symptoms. Analyses revealed that JBO is higher for individuals with high stress and low PA. As a result, PA seems to play a protective role on the development of stress into JBO.
References
Gerber M, Lindwall M, Lindegård A, Börjesson O, Jonsdottir IH. (2013). Cardiorespiratory fitness protects against stress-related symptoms of burnout and depression. Patient Educ Couns, 93, 146–152.

DIRECT AND BUFFERING EFFECTS OF PHYSICAL EXERCISE ON HEALTH: A RCT TO TEST AND EXAMINE THE STRESS BUFFER EFFECT

KLAPERSKI, S.1,2, FUCHS, R.2

1: UNIVERSITY OF ROEHAMPTON (LONDON, UK), 2: UNIVERSITY OF FREIBURG (FREIBURG, GERMANY)

Introduction
Stress is a major threat for health and effective stress regulation strategies are needed. Research has shown that physical exercise can buffer negative stress effects on health; however, its stress buffering role and mechanisms are still not satisfactorily understood. The present study is the first to experimentally test possible mechanisms of the stress buffer effect by examining the effects of a 12-week endurance training programme on stress responses, psychosocial resources, stress-levels, and health.
Methods
We randomly assigned 149 healthy, inactive male employees to a 12-week exercise training, relaxation training, or a waitlist control group. Before (t1), immediately after (t2) and 4 weeks after (t3) the intervention we assessed the subjects' health status, stress levels, psychosocial resources, stress responses, and fitness levels.
Results
T1-t3 pre-post intervention comparisons showed that physical exercise had a direct positive effect on health, self-efficacy, job stress, and the physiological stress response (all p<.05). Relaxation had similar but weaker effects. No clear effects emerged with regard to chronic

stress and social support. A significant stress buffer effect was found (p<.05) but neither the stress response nor psychosocial resources clearly acted as agents.
Discussion
The 12-week exercise programme had various positive health-related direct and buffering effects. However, mechanisms for the moderation effect could not clearly be identified.
Contact
sandra.klaperski@roehampton.ac.uk

Oral presentations

OP-SH09 Sport events and society

SPORT FOR ALL? EXPLORING THE PUBLIC HEALTH REACH OF THE BIRKEBEINER RACES, NORWAY'S ULTIMATE MASS-PARTICIPATION SPORTING EVENTS

CALOGIURI, G.
INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES

Introduction
Inclusion in sports, especially with respect to groups that tend to be the least active (e.g. elderly, ethnic minorities, low socioeconomic status) is viewed as a key strategy for improving population health. Mass-participation sporting events have been increasingly viewed as an arena for inclusion and exercise promotion. However, the public health reach of such events remains an under-researched phenomenon and concerns about the extent of their inclusiveness for all individuals have been raised (Murphy & Bauman, 2007). The Norwegian annual Birkebeiner races (BR) are a popular series of long-distance running, biking and skiing races on forest terrain. Despite efforts to broaden their range of participants, for example by introducing half-distance races and a series of non-timed events, BR are seen by many as an exclusive phenomenon. The aims of this project are to obtain in-depth knowledge about (1) the sociodemographic characteristics of the participants in BR, (2) different psychological factors and perceptions of the race, and (3) which factors are related to participation in the different BR events.
Methods
Data were retrieved from a series of market-surveys carried out by BR organizers. Questionnaire data obtained from the 2016 cohort of Birken participants (overall n = 10,484; age > 15 years) were analysed. Sociodemographic characteristics (sex, age, residence, income, education, and occupation) were examined and possible associations with psychological factors (motives for participating, satisfaction with the race, and future participation intention) were investigated. Qualitative data generated by participants' responses to open-ended questions were analysed thematically in order to understand their subjective experience of the race.
Results
The study started the 1st February 2017. The analyses are ongoing and preliminary findings will be presented at the 22th ECSS conference. These will include descriptive statistics of the sociodemographic characteristics and psychological factors, as well as findings of nominal logistic regression modelling the relation of these variables with participation in the different races. Major themes emerging from the qualitative analysis will also be presented.
Discussion
The findings of this study have the potential to inform campaigns targeting under-represented groups of participants, enhancing the inclusion profile of future BR events and thus maximizing their public health reach. Continuation of this work will seek to analyse data over time (up to 16 years) in an attempt to better understand possible trends among participants Thus, in collaboration with event organisers it is hoped that this research will facilitate the provision of better support to disadvantaged groups.
References
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A QUALITATIVE RESEARCH ON THE MOTIVATION AND CONSTRAINT FACTORS OF CHINESE RECREATIONAL MARATHON PARTICIPANTS

CHEN, X., ZHOU, L.
GUANGZHOU SPORT UNIVERSITY

Introduction
China is experiencing a marathon-boom. According to the Chinese Track and Field Association, the registered marathon and related sports events grew up to 134 games in 2015, with an increase of nearly 10 times ,compared with 13 games in 2010. The number even increased to 323 games with more than 2.8 million marathon participants in 2016[1]. However, it cannot be ignored that there are many constraint factors restricting people to participate in the recreational marathon [2].
Methods
(1) Depth Interview: interviewing the objects one by one via telephone, some social communication tools. All simple interview time was controlled within 30 minutes to one hour. The researchers recorded all of the entire process. .
(2) Text Analysis: collecting and analyzing the concerning texts about marathon from the social communication platform releases by the participants.
(3) Field Investigation: observing the sites of marathon training, competition of the participants and recording the real scenes of participants through the text, pictures and video.
Based on the Grounded Theory, this paper integrated the above methods to carry out the qualitative research progress and encoded all of materials obtained from the interviewing of the marathon participants step-by-step.
Results
1. The Internal Motivation Factors
Among the six intrapersonal motivation factors, interest is mentioned in the highest frequencies by the interviewees.
2. The External Motivation Factors

Among the three external motivation factors, the peer influence is mentioned most. However, the social communication platform software played an important role in stimulating the participants to run so as to gain new material to share and show them.
3. The Personal Constraint Factors
Among the three personal constraint Factors, the injury factor is mentioned in the highest frequency by the object of the interview.
4. The Interpersonal Constraints Factors
The factor of family as a native concept is mainly related to the interpersonal constraints.
5. The Structural Constraints Factors
The structural constraints include four native concepts: time, money, alternative sports, signed or not. The highest frequency of structural constraints was time because it is usually occupied by work, study and family with just a little leisure time.
Discussion
This research explored the motivation factors and the constraint factors of Chinese recreational marathon participants by adopting the qualitative methods. However, it didn't examine the negotiations between the motivation and the constraints. It deserves further study.
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Contact
e-mail: 512920843@qq.com

LEVERAGING SPORT EVENTS TO MAXIMIZE COMMUNITY BENEFITS IN LOW- AND MIDDLE-INCOME COUNTRIES: EXPERIENCES FROM SĀMOA

SCHULENKORF, N., SCHLENKER, K., FRAWLEY, S.
UNIVERSITY OF TECHNOLOGY SYDNEY (UTS)

Introduction
For many years, special events have played an important role as strategic elements within community development (O'Brien, 2006; Taks, Misener, Chalip, & Green, 2013). However, to date little work has been conducted on how to maximize the social potential of special events in low-and middle-income (LMIC) countries. In addressing this issue, we reflect on event management processes and leverage mechanisms that have underpinned a sport-for-development (SFD) event in the Pacific Island nation of Sāmoa, and identify strategies for maximizing beneficial event outcomes. In short, this study set out to empirically investigate leverage opportunities and related managerial processes in the context of community sport events in an LMIC setting.
Methods
Our qualitative research study is underpinned by an interpretive mode of inquiry, which suggests that access to reality can be socially constructed through language, consciousness, and shared meanings (Neuman, 2003). For this study, the lead researcher conducted 20 semi-structured interviews and two focus groups with Sāmoan respondents around a community-based SFD Event in Faleata, Sāmoa. As the investigation aimed to explore and apprehend the socio-managerial processes behind the SFD event—and to elucidate people's ideas and recommendations for leveraging and sustaining event benefits for communities—research participants either held managerial roles or formed part of the local community. Once all data were collected, the authors engaged in a structured thematic data analysis process with the support of the computer software package NVivo 10.
Results
The structured analysis and coding process led to the conceptualizing of data into five thematic leverage areas: (a) Sociocultural, (b) Participatory, (c) Educational, (d) Health, (e) and Reputational. In all areas, strong networks and partnership with supporting institutions from the community and beyond are needed to secure locally relevant and impactful opportunities for maximizing SFD event benefits.
Discussion
Our study highlights that if managed strategically, these benefits can lead to an improved status quo on the sporting field, in the management spheres, in community life, and in institutional relations. In our presentation, specific findings will be presented and discussed in detail; we suggest that they are of significant importance for event planners, SFD managers and academic scholars who set out to use events as strategic vehicles for achieving and maximizing wider community development goals.
References
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18:00 - 19:30

Invited symposia

IS-SP02 Sports engineering methods for sports science: wearable sensors and machine learning - Sponsored by Adidas

IN-FIELD USE OF WEARABLE MAGNETO-INERTIAL SENSORS FOR MOTOR CAPACITY, SPORT PERFORMANCE, OR RISK OF INJURY EVALUATION: STATE OF THE ART AND PERSPECTIVES

CAMOMILLA, V.

UNIVERSITY OF ROME

A successful coaching outcome can be supported by useful and timely feedback to the athlete to target performance defects and protect him from injuries. A systematic, objective and reliable performance monitoring and evaluation, performed by means of qualitative and quantitative analysis of mechanical variables that determine performance, can reinforce the link between research and coaching practice, especially in élite sports. As an alternative to laboratory-based assessments, magneto-inertial sensing is an emerging technology, inexpensive, non-invasive, wearable, and easy-to-use that allows to perform activities in real situations. These sensors, that measure movement-related data, linear and angular motion, open up new perspectives for motor performance evaluation and monitoring.
This lecture highlights the potential for the use of magneto-inertial sensors into an in-field sport setting, by providing a general overview of the spreading in their use through different sports disciplines. Examples of possible assessments of athletes' motor capacity, performance, or risk of injury indicators will be provided. Special emphasis will be placed on the challenge of taking in due account sensors limitations (static bias, drift, sensors-to-body movements), and on good practice rules for a better exploitation of their potential.

WEARABLE COMPUTING SYSTEMS AND MACHINE LEARNING FOR SPORTS SCIENCE RESEARCH

BJOERN, E.

FRIEDRICH-ALEXANDER-UNIVERSITÄT ERLANGEN-NÜRNBERG

Wearable computing systems play an increasingly important role in recreational and elite sports. They comprise of two parts. First, sensors for physiological (ECG, EMG, ...) and biomechanical (accelerometer, gyroscope, ...) data recording are embedded into clothes and equipment. Second, embedded microprocessors (e.g. in smartphones) are used for monitoring and analysis of the recorded data. Together, these systems can provide real-time information and feedback for scientific studies in real sports situations.
Data mining concepts provide tools for analyzing the considerable amount of physiological and biomechanical data that is generated in sports science studies. Especially when using wearable computing systems, the number of participants and variety of measured data is unlimited in general. Traditional statistical analysis methods commonly cannot handle this amount of data easily. Thus, the analysis is often restricted to individual variables rather than multidimensional dependencies and a considerable amount of information is neglected. Moreover, the results are frequently biased by the expectation of the researcher. Here, the objective, data-driven methods from data mining can contribute by offering useful tools for the analysis tasks. These tools have the ability to deal with large data sets, to analyze multiple dimensions simultaneously, to work data-driven rather than hypothesis-driven, and to provide valuable insights into training effects and injury risks.

WHEN MODELING BECOMES THE KEY TO UNDERSTANDING: THE POWER OF MODELING APPROACHES IN SPORTS SCIENCE AND ENGINEERING

SENNER, V., HERMANN, A., KRAUTTER, A.

TUM - TECHNICAL UNIVERSITY OF MUNICH

Many research questions in sports science cannot be addressed by experiments, either because of ethical reasons or because of unsolvable measurement problems. One domain of sports engineering is to develop both, mathematical and physical (mechanical) models in order to simulate reality under various boundary conditions. Whereas objectivity and reproducibility are given, providing adequate model validity is the key challenge of this approach. Finding the best compromise between necessary model complexity and error potentiation due to too many input parameters is sometimes difficult. But still: In many cases even rather simple models (compared to nature) allow systematic sensitivity studies or optimization even towards multiple objective functions.
Describing four research projects which used modeling and simulation approach as key method and illustrating the results derived hereof, the presentation intends to demonstrate the power of this method. Two of these examples (i) footwear design towards turf specific traction behavior and (ii) mechanical stabilization effect of knee braces deal with mechanical models (surrogates). The other two (iii) biomechanical efficiency in (hand)cycling and (iv) the role of passive structures of the foot during running illustrate the application of multibody-models and mathematical simulation.
The talk targets to sport scientists mainly interested in sports technology, biomechanics and modeling.

Invited symposia

IS-PM01 THE ROLE OF THE SYSTEMIC AND LOCAL ENVIRONMENT IN SKELETAL MUSCLE HOMEOSTASIS WITH AGEING AND EXERCISE

THE SYSTEMIC ENVIRONMENT AND AGING: INFLUENCE OF LIFESTYLE FACTORS AND BIOLOGICAL EFFECTS

KADI, F.

SCHOOL OF HEALTH AND MEDICAL SCIENCES

The biological mechanisms responsible for the functional decline during aging remain unknown. A hypothesis that has gained a large consideration in the scientific community is the influence of the systemic environment on age-related decline of the musculoskeletal and cardiovascular function. The presentation highlights epidemiological aspects related to the effects of physical activity/sedentary behaviour on the inflammatory circulating milieu and focuses on mechanisms by which the systemic environment affects cardiovascular and muscular functions. The importance of inflammatory milieu on the molecular aspects of skeletal muscle are addressed as well as the effects of interventions aiming to reduce the systemic inflammation. Data presented is important for professionals involved in the management age-related decline in musculoskeletal function.

CIRCULATING MICRORNAS: INTERPLAY BETWEEN HORMONAL AND INFLAMMATORY SYSTEMS, BODY COMPOSITION AND MUSCLE PERFORMANCE

KOVANEN, V.

UNIVERSITY OF JYVÄSKYLÄ

Aging is a process influenced by combination of genetics and changes in environmental factors which contribute also on the age-associated muscle weakness. In this presentation, the interplay between hormonal and inflammatory systems is highlighted with special focus on microRNAs (miRs), the epigenetic small non-coding regulatory RNAs present in all cell types and in the bloodstream. Specifically, the circulating miRs of women at different ages and sex steroid status and young and elderly male master athletes are under consideration. Also possible associations with body composition, muscle performance and inflammatory status are highlighted together with the modulatory effects of exercise training. The lecture addresses important aspects related to exercise physiology and aging as well as rehabilitation medicine.

CHANGING THE LOCAL AND SYSTEMIC ENVIRONMENT TO IMPROVE THE ADAPTATION OF HUMAN SKELETAL MUSCLE

MACKEY, A.

UNIVERSITY OF COPENHAGEN AND BISPEBJERG HOSPITAL

This talk will address the topic of pharmacological interventions (which are feasible in humans) to alter the systemic and local environment of skeletal muscle with the goal of improving regeneration after injury or simply restoration of acute losses in muscle mass. Non-steroidal anti-inflammatory medication and Angiotensin II receptor blockers in particular will be focused on as potential pharmacological interventions in the context of key cell populations involved in muscle adaptation. Satellite cells, fibroblasts, and inflammatory cells, in particular pro- and anti-inflammatory macrophages, will be discussed. The relevance of this talk is that it addresses the problem of unsuccessful muscle repair and restoration, which is a pervading issue for a broad spectrum of individuals, from elite athletes to frail individuals.

Oral presentations

OP-PM21 Talent identification and development

VALIDITY OF EARLY TALENT SCREENING AND TALENT ORIENTATION

HOHMANN, A., FEHR, U., SIENER, M., HOCHSTEIN, S.

UNIVERSITY BAYREUTH

Introduction
Talent identification in elementary school is often regarded as not valid. Therefore, the aim of this longitudinal study was to analyse the prognostic validity of an early talent screening and talent orientation.
Methods
The Fulda Movement Check (FMC) 2010-2016 is a yearly talent search campaign including a total population of 1,800 second class children (Nmale = 4,805; age M = 94,93 mon; SD = 6,07). The FMC consists of the eight tests of the German Motor Test 6-18 (Boes & Schlenker, 2016) plus body height, body weight, and a ball throw. Until the end of 2016, the competition performances of a sample of former participants tested in the years 2010-2013 (Nmale = 539; age M = 149.44 mon; SD = 10,61) were collected. On the basis of the initial talent make-up data a linear discriminant analysis (DA) and a nonlinear neural network (multilayer perceptron, MLP) were used to predict the specific sport that the youth athletes performed 3-6 years later (Pion et al., 2016). Furthermore, it was tested whether those children that had chosen one of the three sports recommended in the early talent orientation procedure reached better performances than their non-following counterparts.
Results
The youth athletes had chosen a total of 36 different sports, with the biggest groups competing in soccer (n = 54), tennis (n = 50), table tennis (n = 32), track and field (n = 30), and judo (n = 24). On the basis of unweighted test data, a cross-validated DA led to 32.5 percent correctly classified individuals in regard to their later sport. By means of the MLP (hold-out: 15 percent), 29.9 percent of the cases were predicted correctly. After introducing specific weight factors for the 11 measures according to the relevance of each performance prereq-

uisite in the five sports, the DA led to 39.5 percent correct hits, and the MLP allowed for 44.7 percent positive cases. Due to the small number of participants in each sport, no significant differences in the mean values of the later competition performances could be found. Nevertheless, the effect sizes (Cohen, 1988) between followers and non-followers were d = -0.20 in table tennis, d = 0.06 in soccer, d = 0.14 in track and field, d = 0.25 in tennis, and d = 0.32 in judo.
Discussion
Talent identification campaigns at Elementary School age allow for the classification of future youth athletes into their preferred sport in almost half of the children. In four out of five sports, those participants having followed one of the three recommended sports afterwards show better competition results.
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LONG-TERM STABILITY OF SPORT PERFORMANCE DURING CHILDHOOD

SIENER, M.1, HOHMANN, A.1, YIN, X.2
1: UBT (BAYREUTH, GERMANY), 2: SUS (SHANGHAI, CHINA)

Introduction
Many talent identification programs (Golle et al., 2015; Pion, 2015) aim to assess the early sport performance of elementary school children at the age of 6 to 9 years. In the context of talent forecast the question arises whether early sport performances remain stable during childhood and whether this consistency applies for the general population as well as to participants in competitive sports. Therefore, the aim of this study was to analyze the stability of sport performance in children from second (M = 92.24 mon; SD = 4.86) to seventh class (M = 153.12 mon; SD = 4.95).
Methods
In the Fulda Movement Check 2011 (FBC 2011) more than 1,500 kids were tested. N = 295 of them took part in a follow-up testing five years later in 2016. The participants of the FBC were parted into three groups: the best 15 percent of the participants form the best movers group that are supported by talent centers. The lowest 15 percent are subject to a health promotion program. The medium fraction of the children (70 percent) just get a sport recommendation. To examine differences among the three performance groups a 3 (group)*2 (time) analysis of variance with repeated measures was conducted.
Results
In a first step, a correlation study shows that the total sum of the Standard Deviation Scores (SDS) of the eight tests (20-m sprint, balancing backwards, sideward jumping, bend forward, push-ups, sit-ups, standing long jump, endurance run) of the German Motor Test 6-18 (Boes & Schlenker, 2016) plus a ball throw shows a medium stability (rtt = .55; $p < 0{,}001$). The highest correlation coefficient occurs in the ball throw (rtt = 0.69; $p < 0{,}001$) and the lowest one in the push-up test (rtt = 0.27; $p < 0{,}001$). The 20-m-sprint which is a prominent talent indicator shows a medium stability over time of rtt = 0.50; $p < 0{,}001$). The analysis of variance with repeated measures demonstrates that all three groups improved their performance ($F_{Time}(0;1) = 842.45$; $p < 0.001$) over the 5-years period. Although the differences in motor competence are persisting ($F_{Group}(0;2) = 6.57$; $p = 0.002$), the low performance group caught up to the average performance group ($F_{Time*Group}(1;2) = 11.03$; $p < 0.001$).
Discussion
The results show that most of the sport performance components remain more or less stable over the investigated 5-years period. This finding supports the hypothesis that talent screening at elementary school age is a feasible solution to indicate the talents of tomorrow.
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PERFORMANCE PREDICTION IN YOUTH SOCCER TALENTS

PIETZONKA, M., HE, R., THEN, F.
UNIVERSITY OF BAYREUTH

Introduction
Talent identification is important for the development of modern soccer (Reilly, Bangsbo & Franks, 2000) of prognostic validity at an early age is a paramount question that needs to be addressed.
Methods
Since 2010, the Institute of Sport Science has conducted the Fulda Movement Check campaign. Every year, the total population of second class children of the elementary schools of the Fulda district (N = 1,800) completed the German Motor Test 6-18 (GMT 6-18; Boes & Schlenker, 2016) plus a ball throw. The GMT 6-18 consists of the eight tests 20-m sprint, balancing backwards, sideward jumping, bend forward, push-ups, sit-ups, standing long jump, and 6-min-run. All children got a diploma documenting the test results and the recommendation of three sports suited best for the individual. In this study N = 176 participants were followed over a 3-6-years from age eight (M = 97,52 mon; SD = 7,73) until the age group Under-15 (M = 156,74 mon; SD = 5,37). At the age of U-15 the competition soccer performance of each player was registered and two groups were formed. Group 1 (n = 137) contained the players with the lowest performance from local level 1 to regional level 3. Group 2 (n = 37) consisted of the players with higher performances between provincial and national level (level 4-6). Group differences in the 9 measures and the competition performance were analyzed by T-Test ($p < 0.05$). In a second step, a stepwise linear regression was used to determine which tests were decisive for performance prediction. Finally, a T-Test was used to proof whether the players with an initial soccer recommendation (group SOC) exhibited 3-6 years later a higher soccer performance than those without such a recommendation (group OTH).
Results
At the end of the 3-6-years period the SOC group reached significantly ($p < 0.05$) better results than the OTH group in 20-m sprint, balancing backward, sideward jumping, bend forward, push-ups, sit-ups, standing long jump, and ball throw. Furthermore, the T-test showed that children having got an initial soccer recommendation developed a higher overall soccer performance at age U15. The stepwise regression analysis showed that 13 percent of the later soccer performance could be predicted by the nine motor tests. The sideward jumping and the 20-m-sprint contributed most to the explanation of the variance ($R2 = .13$; $F(1;52) = 19.63$; $p < .01$).

Discussion
The GMT 6-18 plus ball throw is a valid tool to identify children suited for soccer. Although, the talent campaign of the German Soccer Federation (DFB) with more soccer specific testing starts later at the age of 12 years, the GMT 6-18 plus ball throw at age eight is a worthwhile instrument of predicting youth soccer performance.
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EXPLORING DIFFERENCES AND SIMILARITIES FOR TALENT TRANSFER IN BASKETBALL, SOCCER AND VOLLEYBALL.

PION, J., MOSTAERT, M., WAZIR, M.R., LENOIR, M.
HAN UNIVERSITY OF APPLIED SCIENCES

Introduction
The Flemish Sports Compass (FSC) is an instrument that allows the orientation of children to sports, based upon their personal characteristics as well as on the coaches' opinion on the necessary characteristics. This study investigated whether these two perspectives are useful for the talent transfer process also, by comparing similarities and differences between sports.
Methods
Firstly, a coach's survey was conducted to analyse the coaches perceived needs for three team sports (n= 27 items). Coaches (n= 136) in three sports, basketball (n=26), soccer (n=71) and volleyball (n=39) participated in this study. Secondly, a sample of 67 junior elite male athletes U18 (16.1 ± 0.8 years) post age at peak height velocity (PHV; maturity offset = 2.7 ± 0.9 years) was assessed using a generic test battery which, identified to what extent these junior elite had the capacity to perform well in a given team sport. The participants competed at an international level in basketball (n=27), soccer (n=20) or volleyball (n=20). The aim of the study was to investigate the discriminative power from the survey and the generic test battery.
Results
The first discriminant analysis used the three team sports as grouping variable and the coaches' perceived performance characteristics as independent variables. The predictive model correctly classified 97.8% coaches; cross-validation by the leave one out method resulted in 94.1% correctly classified coaches (rCan = .925; Wilk's λ = .047; $p < .001$; df = 40). The second discriminant analysis used the three team sports as grouping variable and 19 performance characteristics as independent variables, which resulted in a 98.5% correct classification rate and cross-validation of 91.0% correctly classified athletes (rCan = .943; Wilk's λ = .030; $p < .001$; df = 38).
Discussion
It is possible to discriminate between basketball, soccer and volleyball by means of two different methods, the coach's survey and the generic test battery. The results highlight the specific demands for each sport and at the same time similarities are stressed, since the investigated performance characteristics are both specific and generic. This study showed differences and similarities for talent transfer in basketball, soccer and volleyball, which offers perspectives for sampling these three sports.
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TALENT IDENTIFICATION AND DEVELOPMENT IN SWIMMING

ELFERINK-GEMSER, M.T., KOCH, M., GIJSBERS, Y.S.P., VISSCHER, C.
UNIVERSITY OF GRONINGEN, UMCG

Introduction
Several factors have been related to swimming performance, such as drag, hydrodynamics, and propulsion efficiency (Naemi et al., 2010; Toussaint et al., 2000). These factors may be related to multidimensional performance characteristics of the swimmers, such as their anthropometrics. To understand the potential impact on talent identification and development, the aim of this study was to investigate whether anthropometric data can predict same-year and future swimming performance in youth swimmers.
Methods
Male youth swimmers (n=33; mean age=14.29, sd=1.17) who were all enrolled in the talent development program of the Royal Dutch Swimming Federation (KNZB) participated. Two backwards stepwise hierarchical linear regression analyses were performed with age, maturity offset and 10 anthropometric variables as predictors and FINA score as dependent factor. Same-year swimming performance was based on the FINA score in the year of measurements, future swimming performance was based on the FINA score one year after the measurements.
Results
Same-year swimming performance could be predicted by age, upper leg length, buttocks-foot length, and hand width ($p<.05$; $R^2=83\%$). For future swimming performance age, upper leg length, and hand width were significant predictors ($p<.05$; $R^2=74\%$).
Discussion
Over 80% of variability in swimming performance of male talented swimmers aged 12-16 can be explained by a combination of age and anthropometric characteristics related to their legs and hands. Explained variability of future performance one year later was almost 75% underlining the importance of age and anthropometrics for performance in youth swimmers. Since anthropometrics are influenced by growth and maturation to great extent (Malina et al., 2004), caution is warranted when identifying talent in swimming solely on FINA scores.
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Contact
m.t.elferink-gemser@umcg.nl

Invited symposia

IS-BN03 MUSCLE-TENDON UNIT PROPERTIES AND RUNNING ECONOMY

TENDOMUSCULAR FACTORS AFFECTING THE METABOLIC COST OF RUNNING

ARAMPATZIS, A.

HUMBOLDT-UNIVERSITY BERLIN

There is evidence that biological systems optimize their locomotion to minimize its energy cost. Based on that, it can be hypothesized that the properties of the human system might be the main determining factors that affect the cost of locomotion and not the motion execution. Tendons, due to their compliance, allow the muscle fibers to contract at lower shortening velocities and, in this way, increase the muscle potential to generate force. A higher muscle force potential would decrease the volume of active muscle at a given force or rate of force generation and consequently would decrease the cost of force production as well. Furthermore, tendons reduce the mechanical work done by their muscle fibers in each step as a result of their elasticity and reduce the metabolic cost of locomotion. During the loading phase, part of the mechanical energy coming from the mammal's body is stored as strain energy in the tendon and converted again into mechanical energy in the following shortening phase. Muscles and tendons, due to their plasticity, are able to remodel their mechanical and morphological properties in response to mechanical loading. The possibility of a training-induced change in the muscle-tendon properties and the investigation of the effects on running economy introduce an interesting experimental approach to control mechanisms that may affect running economy. In our first experiment we investigated the relationship between tendomuscular factors and running economy. We found that neither kinematic parameters nor morphological properties of the muscles relate to running economy. However, the most economical runners showed higher contractile strength in the plantar flexors and higher Achilles tendon stiffness. It has been supposed that these specific tendomuscular properties would increase the force potential of the muscle while running, affecting running economy. In a second step we investigated the effects of mechanical loading on tendon adaptation. We found that a high strain magnitude applied to the tendon, an appropriate strain duration and repetitive loading are essential components for an efficient adaptive stimulus. In our next experiment we investigated the effects of an increased Achilles tendon stiffness and contractile strength of the plantar flexors on running economy. After the training, muscle strength increased by 7%, Achilles tendon stiffness by ~16% and running economy by ~4%. However, neither fascicle length nor fascicle velocity of the gastrocnemius medialis were affected while running. We expect a redistribution of the muscular output within the lower extremities that might explain the improved running economy, due to the alteration of the tendomuscular properties. Currently we are investigating this expectation using the non-linear Lyapunov analysis and the muscle synergies concept in running.

SKELETAL MUSCLE ENERGETICS AND TENDON STIFFNESS: IMPLICATIONS FOR ENERGY COST OF RUNNING

MACINTOSH, B.R.

UNIVERSITY OF CALGARY

It has been reported that a more stiff Achilles tendon correlates with decreased energy cost of running. We confirmed this and demonstrated that a change in stiffness correlated with a change in energy cost of running; increased energy cost with decreased stiffness and decreased energy cost with increased stiffness. This correlation with change was shown before and after a long run as well as following a period of training. We addressed the question of whether or not skeletal muscle energetics could explain this relationship. A stiffer tendon will result in less shortening and slower shortening of the gastrocnemius muscle fascicles and using near infrared spectroscopy we showed that greater shortening and faster shortening increased muscle energy cost. A theoretical consideration of the factors contributing to the energy cost of muscle contraction is consistent with this notion. Cross-bridge turnover to accommodate shortening of fascicles can explain the increased energy cost associated with a more compliant tendon. This was determined by estimating the number of simultaneous cross-bridges needed to generate the necessary force and the number of half-sarcomeres in series and the turnover of cross-bridges required for length change. This theoretical model can provide information on optimal muscle properties for the energy cost of running. Limitations include that other muscles are required besides the gastrocnemius muscle, but this is a good beginning to understanding muscle energetics in the context of human movement.

MUSCULOSKELETAL CHARACTERISTICS AND FUNCTION DURING RUNNING FOR TOP LEVEL ENDURANCE RUNNERS

ISHIKAWA, M., SANO, K., KUNIMASA, Y., MAKINO, A., NICOL, C., KOMI, P.V.

OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES

From the studies performed on the East-African runners (EAR), their high running economy can be considered as one of the key factors of their success. However, their high running economy could not be explained by any of the physiological and/or histochemical parameters (Saltin et al 1995). Therefore, it was a clear conclusion of their reports of Saltin et al (1995) that one of the possible reasons for both high mechanical efficiency and improved running economy may be the special biomechanical make-up of these runners. The purpose of this presentation was to show 1) whether the EAR possess a particular type of musculoskelton, 2) how these specific musculoskelton can provide function to enhance running economy and 3) whether their specific musculoskeletal characteristics of lower-legs are congenital or acquired.

The data for East African and Japanese middle- and long-distance junior and senior male runners, who participated in major national and/or international running competitions, are reported in this presentation. Musculoskeletal ultrasonography, EMG and kinematics for lower leg were used together with ground reaction forces during their running.

From the anatomical point of view, however, EAR was greater Achilles tendon (AT) length and its moment arm, and smaller ankle lever ratio as compared to Japanese distance runners. During running, EAR showed smaller AT stretching and shortening amplitudes during contact, but greater tendon contribution to the muscle-tendon unit shortening. In muscle fascicles, EAR showed the smaller fascicle length changes together with smaller muscle activation for medial gastrocnemius (MG) muscle during running. In contrast, the Japanese runners followed the classical stretch-shortening cycle (SSC) muscle activation profiles, such as relatively high MG muscle activities during the pre-activation and braking phases. Consequently, greater tendon contribution to the muscle-tendon unit shortening during running but smaller AT stretching with smaller muscle activation during braking phase of running might be caused by the longer AT moment arm and stiff ankle joint stiffness for EAR.

However, long AT and its moment arm for EAR were similar to those for Kenyan in general population, but length of muscle fascicles was smaller as the age group increases.
These results suggest that the unique neuromuscular interaction utilizing inherent anatomical benefits for EAR can be a unique alternative to the classic SSC concept for enhancing running performance by greater storage of elastic strain energy. In addition, these specific musculoskeletal characteristics of lower-leg for EAR can be common feature among Kenyans rather than the results of the specific training adaptation of EAR.
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Oral presentations

OP-PM22 Strength training

ISOKINETIC ECCENTRIC HAMSTRING TRAINING AFFECTS SPRINT KINETICS

KNICKER, A., ALT, T., RODLER, Y., SEVERIN, J., KOMIK, I.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Hamstring strain injuries are common in sports where sprinting is a predominant constituent of performance. There is ample evidence that imbalances of the muscles generating moments around the knee joint are responsible for their occurrence (Guex, 2013). Although eccentric hamstring exercises are consistently recommended to overcome these imbalances a direct evaluation of the effects on knee flexion and extension moments during the swing phase in sprinting has not been published yet. The aim of the present study was to investigate kinematic and kinetic parameters of the 'Nordic hamstring exercise' (NHE) and the effects of a NHE training intervention on knee extension and flexion moments during the swing phase of sprint running.
Methods
For this purpose, 16 sprint athletes completed a four-week isokinetic NHE training. In order to control execution speed through the full range of motion, in half of the training sessions the subjects were supported by a special rope and harness device (assistive training). For the determination of load parameters the training was performed on a dynamometer. Before and after the training isokinetic measurements of the hamstrings and the quadriceps were taken, and a kinematic sprint analysis was carried out. Individualized lower limb inertial properties enabled inverse dynamic calculations of knee moments during swing phase.
Results
The results of the present study revealed significant improvements of the isokinetic eccentric knee flexion peak moment of up to 14%. In all hamstrings to quadriceps ratios, a significant increase was noted after the training. During the sprint maximum knee flexion moments at the end of swing phase were increased after the NHE training. However maximum running velocity remained unchanged.
Discussion
Acute effects of NHE on knee flexion moments could be revealed in the current study. Increased isokinetic dynamic control equilibrium (Alt, 2016) was reflected in higher knee flexion moments during the late swing phase of sprinting (Chumanov, 2011). According to these results the NHE is an intensive and effective exercise to minimize risk factors for hamstring muscle injuries.
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EFFECTS OF A 4-WEEK ROPE-TRAINING ON MOBILITY, STRENGTH AND COORDINATION COMPARED TO A MACHINE BASED STRENGTH TRAINING

WRIGHT, P.1, JUERGENS, S.2
1 OXFORD BROOKES UNIVERSITY, 2 CHEMNITZ UNIVERSITY OF TECHNOLOGY (GERMANY)

Introduction
Rope training to date has been predominantly applied in competitive sports, but is increasingly used by a broader population in a fitness training context. The very few publications concerning this training method have mainly investigated the metabolic and cardio-respiratory effects of rope training. This study therefore investigated for the first time the potential effects on mobility, strength, coordination and balance respectively and compared them against conventional machine based strength training in a fitness population.
Methods
21 strength/fitness training experienced participants (15m; 6w) were randomised and allocated to either a rope training group (RTG; n=12) or a conventional strength training group (STG; n=9). Both interventions were conducted over a period of 4 weeks with 3 interventions/week. The pre- and post-test battery consisted of the following tests: functional mobility was assessed using muscle function tests according to JANDA (MFT), for movement coordination the Functional Movement Screen (FMS) was applied and static and dynamic balance was assessed with the T-bar test (TBT) and the Y-Balance test (YBT) respectively. Isometric strength (ISO) and grip strength tests (GST) served for testing maximal strength.
Results
Within the 4 week intervention period only the RTG showed significant improvements – in functional mobility ($p<0.01$), movement coordination ($p<0.01$) as well as dynamic balance ($p<0.05$). Both groups showed improvements in strength, but again only the RTG demonstrated significant improvements in the hamstrings, abdominal muscles and hip flexors (all: $p<0.05$).
Discussion
According to these results it can be concluded that a 4-week rope training improves functional mobility, maximal isometric strength, coordination and dynamic balance in fitness trained adults and recreational sport people. Conventional machine based strength training proved to be less effective in this population. This could be partly due to emphasis on core stability, the high demand on inter- and intramuscular coordination and the generally high intensity in rope training. Future longitudinal studies should therefore investigate this comparison over a longer intervention time with a greater N as well as the possible application of rope training in injury prevention and rehabilitation of orthopaedic conditions.

HIGHER LIFTING SUCCESSFUL RATE WHEN USING INTRA-SET REST DURING BENCH PRESS EXERCISE

WONG, D.P., HO, I.M.K., LUK, J.T.C., NGO, J.K.
SHANDONG SPORT UNIVERSITY

Introduction
The aim of this study was to examine the effects of intra-set rest (ISR) durations on successful lifting rate and the perceived exertion in bench press exercise.
Methods
34 physically active males (age: 21.2±1.7 years; and 6RM load: 52.5±13.7kg) participated in this repeated-measure study and visited the laboratory four times: 1st visit, to determine 6 repetition maximum (6RM) load; and 2nd to 4th visits, to perform three ISR conditions in counterbalanced order. The ISR durations were: 0s (R0), 20s (R20) and 40s (R40). ISR was placed after the first three repetitions of each set. Each bench press protocol consisted of 3 sets each with 6 repetitions, but varied in ISR duration. 180s, 160s, and 140s between-set rest durations were respectively assigned to R0, R20, and R40 in order to equalize the total duration among the three conditions. Lifting tempo was set at 2s for upward and 2s for downward movement. Lifting positions and tempo was registered by a velocity transducer together with a portable electronic metronome for audio signals. Successful lifting rate was calculated as the number of participant who completed all repetitions in each condition divided by the number of total participant. Rating of perceived exertion (RPE) of participant was recorded immediately after each set of bench press exercise using Borg's 6-20 scale. Differences between conditions were assessed via respective 95% confidence intervals. Cohen's d was used as effect size (ES) to determine practical effect: trivial (below 0.2), small (0.20–0.49), medium (0.50–0.79), and large (0.8 and above).
Results
Results indicated that 23 participants successfully completed all required repetitions in the three conditions, whereas 11 participants could not complete all repetitions. Number of successful repetitions were: 1st set (R0: 6.0±0.0 rep; R20: 6.0±0.0 rep, R40: 6.0±0.0 rep); 2nd set (5.8±0.6 rep; 6.0±0.0 rep; 6.0±0.0 rep. ES between R0 and R20 = 0.28, between R0 and R40 = 0.28); and 3rd set (5.5±0.9 rep; 5.8±0.5 rep; 6.0±0.2 rep. ES between R0 and R20 = 0.51, between R0 and R40 = 0.56, between R20 and R40 = 0.29). Successful lifting rates were: 67.6% for R0, 85.3% for R20, and 97.1% for R40. RPE scores after each set were: 1st set (R0: 11.4±2.8; R20: 11.2±2.1; R40: 11.0±2.6. R0 vs. R20: 95% CI [-0.17:0.93], ES=0.24; R0 vs. R40: [0.05:1.07], ES=0.39; R20 vs. R40: [-0.36:0.71], ES=0.12); 2nd set (12.9±2.7; 12.9±2.3; 12.4±3.0. R0 vs. R20: 95% CI [-0.22:0.63], ES=0.17; R0 vs. R40: [0.10:1.02], ES=0.43; R20 vs. R40: [-0.22:0.92], ES=0.22)); and 3rd set (14.1±2.6; 14.1±2.5; 13.5±3.2. R0 vs. R20: 95% CI [-0.36:0.54], ES=0.07; R0 vs. R40: [0.26:1.21], ES=0.55; R20 vs. R40: [0.02:1.27], ES=0.36).
Discussion
R20 and R40 both increased the successful lifting rate and had positive medium effect on the number of successful repetition during the third set of bench press as compare to no ISR. Moreover, R40 had medium effect which decreased the RPE during the third set of bench press exercise as compared to no ISR.

INTERMITTENT HYPOXIC RESISTANCE TRAINING AFFECTS THE FORCE-VELOCITY PROFILE

FERICHE, B., MORALES-ARTACHO, A.J., GARCÍA-RAMOS, A., PÉREZ-CASTILLA, A., PADIAL, P.
GRANADA UNIVERSITY

Introduction
Terrestrial hypoxic environment appears to create advantageous responses in the development of muscle performance with improvements in both muscle strength and the speed of explosive movements. The reduction in the aerodynamic resistance and/or the increase in the anaerobic metabolism at higher altitudes may influence the metabolic cost, improve take-off velocities, or affect motor unit recruitment patterns, which could explain improved muscle contraction properties (Levine et al. 2008; Shoenfeld, 2013). Enhancements in explosive movements have been shown to occur at acute altitude (Feriche et al. 2014; García-Ramos et al. 2016), what together with the increased spinal excitability described in this condition (Tomazin et al. 2016), can make us to consider that permanence in altitude may not be needed to reach such effects. Therefore, the aim of this study is to analyze the influence of intermittent hypoxic resistance training on the force-velocity profile.
Method
Twenty-three men performed a 4-week power-oriented resistance training program (RT) either under normoxia (n=11; N,690 m) or intermittent terrestrial hypoxia (n=12; IH,2320 m). Before and after the training intervention, maximum values of force and velocity were recorded during a five-load submaximal countermovement jump test to determine maximum theoretical force (F0), velocity (V0), and power (P0) in N conditions.
Results
N group displayed trivial effect for V0 (P=0.61, ES=-0.19; -4.98%), while small to moderate changes were found for F0 (P=0.06; ES=0.96; 12.34%) and P0 (P=0.06; ES=0.45; 7.24%). On the contrary, the IH group showed small changes for F0 (P=0.55; ES=0.42; 4.11%) and from moderate to large for V0 (P=0.11, ES=1.04; 24.22%) and P0 (P=0.004, ES=1.65; 21.09%).
Discussion
These results reflect different changes in the F-V profile when RT is performed in N or IH conditions. As expected, the P0 changes observed in the N group are linked to F0 improvements with no meaningful changes in V0. Contrary, the increase in P0 at IH is caused by an improvement in V0 with no significant changes in F0. Previous studies have revealed similar results under acute hypoxia conditions (García-Ramos et al. 2016). The main reason may be attributed to a reduction in the aerodynamic resistance (Feriche et al. 2014; Levine et al. 2008). However, neuromuscular (Tomazin et al. 2016) and metabolic (Schoenfeld, 2013) contributory mechanisms could also influence muscle contraction properties and thus improve explosive speed from just after the ascent. Therefore, the "Living low-Training high" strategy during RT revealed to be useful in the ability of the neuromuscular system to produce higher power as a result of velocity improvement.
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Contact
mbelen@ugr.es

EFFECTS OF CONCENTRIC VERSUS ISOMETRIC NECK STRENGTH TRAINING IN RUGBY PLAYERS.

PAIZIS, C., ARVOUET, B., COMETTI, C., BABAULT, N.
CENTRE D'EXPERTISE DE LA PERFORMANCE, INSERM U1093,

Introduction
Rugby players generally take repeated head impacts and this can cause serious injury to the cervical spine (Brooks at al., 2005). A strong and powerful neck allows among others to cushion the shocks and prevent them from affecting the cervical spine. In this context, the aim of our study was evaluated and compared concentric versus isometric strength training on the neck.
Methods
A population of 26 subjects was selected, male, practicing rugby at amateur level, having suffered no injuries in the cervical, with an average age of 22,4 years ± 2,8years.
A group (n = 13) was defined to achieve the concentric protocol and the other group (n = 13) applied the isometric protocol. Our experiment was conducted for six weeks, with two sessions per week. The parameter measured was the Isometric Force on the four sides of the neck: Extension (E), Flexion (F) Right Lateral Flexion (RLF), and Left Lateral Flexion (LLF). The measurements were performed pre and post protocols with a digital force gauge which was validated in a previous study (Geary et al., 2013).
Results
The results of our work have shown that the two protocols allowed a significant increase in neck strength ($p < 0.05$) in all sides except the front extension (E) where in this case, only the protocol had concentric allowed a significant increase. In addition, on all 4 sides the increase was greater for the concentric group compared to the isometric group (14% average growth due to the concentric protocol against 6% growth average for the isometric protocol).
Discussion
The results of the present study indicate that a 6-week concentric neck strengthening program is more effcient than an isometric strengthening program in rugby players. This study could therefore be used for physical trainers for planning strength training on the cervical spine, also the medical world to enhance rehabilitation and specific rehabilitation programs in this joint. However, further research will have to be carried out to observe whether the increase in neck muscle strength could significantly reduce the risk of cervical injury, because there are divergent opinions in the literature (Naish et al., 2013).
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METABOLIC EQUIVALENTS AND ENERGY EXPENDITIRE IN 3 DIFFERENT TYPES OF "CONCURRENT" TRAINING PROTOCOLS

ALCARAZ, P.E.1,2., MARÍN-PAGÁN, C.1, MARÍN-CASCALES, E.1, FREITAS, T.T.1, MARTÍNEZ-NOGUERA, F.J.1, CARLOS-VIVAS, J.1, RUBIO-ARIAS, J.A.1,2, RAMOS-CAMPO, D.J.1,2, CHUNG, L.H.1
UNIVERSIDAD CATÓLICA DE MURCIA

Introduction
It is well known that concurrent increases of both maximal strength and aerobic capacity are associated with improvements in performance, as well as overall health (1). The most popular training methods used for achieving these objectives are high-intensity resistance circuit (HRC) training (2), high-intensity interval (HIT) training (3), and traditional concurrent (TC) training. However, it is unclear if there is a difference in the metabolic responses over time in the different protocols. Therefore, the aim of this study was to examine the acute metabolic equivalents (MET´s) and energy expenditure (EE) following HRC, HIT and TC.
Methods
11 recreationally-active males (24.5 ± 5.1 SD years) performed each 1 of the 3 training protocols in a randomized order with 7 days of rest between sessions. The HRC was a circuit-based with active rest, for TC, traditional training with passive rest. Both HRC and TC consisted of 3 sets of 6 exercises at 6RM with 3 min of recovery. In addition, TC contained 20 min of treadmill running at VT2. For HIT, participants performed 36 all-out sprints of 20 m (2 blocks of 3 sets of 6 sprints/set; 15s rest between sprints; 3 min rest between sets). For each protocol, there was 5 min of rest between blocks. O2 and CO2 were measured using a gas analyzer at rest, during exercise, and at 30 min post-exercise. To calculate the EE during the training protocol, the equation described by Weir (4) was used: EE = 1.59 • VCO2 + 5.68 • VO2 - 2.17 • UN. UN was assumed as a constant value (15 gr•day-1). To calculate EE after exercise, we used the equivalence of 1 Litre of O2 = 4.64 Kcal.
Results
The main findings of this study were that TC produced higher ($p \leq 0.001$) absolute (MET´s) and relative (MET´s•min-1) values when compared to HIT and CT training protocols. In addition, these differences were significant between HIT and HRC. Regarding the EE, the TC provoked a significant ($p \leq 0.001$) demand of Kcal when compared to HIT and HRC. However, when the EE was normalized to time (Kcal•min-1), there were only significant differences between HRC and the other two training protocols, HRC group being the lowest.
Discussion
The following study shows that from a metabolic point of view, TC produces higher levels of MET´s and EE. However, when the data was normalized, the HIT and TC burned similar levels of Kcal. This study provides an overall understanding (during and post-30 min of exercise) of the metabolic and energetic responses in three distinct concurrent protocols.
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Contact
palcaraz@ucam.edu

Oral presentations

OP-BN08 Sport technology

ERROR CORRECTION PROCESSING IN TIMING LIGHTS: DOES IT WORK?

ALTMANN, S., BECKER, B., RINGHOF, S., NEUMANN, R.
KARLSRUHE INSTITUTE OF TECHNOLOGY

Introduction
Single beam timing lights are frequently used in order to monitor sprint performance of sport athletes. Although more accurate than manual timing, single beam timing lights are not free from measurement errors (ME), e.g. prematurely triggering by a swinging arm or leg (Altmann et al., 2015). To improve accuracy, systems employing error correction processing algorithms (ECP) have been developed. These systems process all triggerings as an athlete passes through the timing lights and take the longest triggering as the correct signal (Haugen & Buchheit, 2015). To date, no study quantified ME when using ECP. Therefore, our purpose was to investigate if ECP is able to eliminate or to reduce ME, both in a controlled and in a real sprint condition.
Methods
In the controlled condition, a dummy consisting of 3 timber beams of different widths was used to simulate the consecutive triggering of an athlete's leading hand, torso, and trailing hand. The dummy moved through the timing lights 10 times with speeds between 6 and 13 km/h.
In the real condition, 15 male sports students performed all-out sprints over 5 and 10 m. In both conditions, timing lights with ECP and a high-speed camera (200 fps) were used to simultaneously capture the dummy or the athletes' trunk, respectively, when passing the timing lights. The high-speed camera served as a reference and was used to determine ME of the timing lights. ME was determined by computing the time difference between the signal taken by the timing lights and the actual passing of the torso detected by the video image. As an absolute measure of inter-trial reliability, root mean square errors (RMSE) were calculated.
Results
In the controlled condition, ME was 0.001 ± 0.002 s (mean ± SD). In the real condition, ME was 0.007 ± 0.029 s for the start, 0.001 ± 0.005 s for the 5 m, and 0.002 ± 0.005 s for the 10 m timing light. RMSE were 0.062, 0.010, and 0.013 s, respectively. As proven through video analyses, ECP eliminated nearly all false signals in both conditions, except for 4 signals at the start timing light in the real condition. Highest ME for the start timing light was 0.134 s.
Discussion
ECP worked in both conditions by eliminating almost all false signals, reducing ME to 0.001–0.007 s. Compared to a previous study (Altmann et al., 2015), in which ME for single beam timing lights without ECP was 0.180 s, this indicates a dramatic reduction of ME. The 4 false signals for the start timing light were caused by a distinct forward leaning of the athlete. Therefore, clear instructions concerning starting posture should be given to further improve measurement accuracy of the start timing light. Additionally, this approach could also enhance inter-trial-reliability. Nevertheless, based on our results, timing lights employing ECP can be recommended for measuring short sprints.
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Contact
Stefan.Altmann@kit.edu

DETERMINING JUMPING HEIGHT OF THE VOLLEYBALL SPIKE JUMP BY IMU

SCHMIDT, M.
TU DORTMUND UNIVERSITY

Introduction
Spiking the ball at maximal height is a crucial factor of playing performance in volleyball (Wagner et al., 2009). As spiking height is mainly determined by vertical jumping abilities, performance diagnostics often include tests such as counter movement jumps. These tests allow an approximation of the jumping height that might be achieved under competitive conditions. Inertial measurement units (IMU) offer a promising alternative for in-field diagnostics. In this study the accuracy of determining volleyball spike jumping height under field-based conditions using an IMU-based mobile device depending on sensor positioning was investigated.
Methods
23 volleyball players (9 female, 13 male) performed a total of 106 volleyball spikes. Three IMU devices (Jaitner et al., 2016) consisting of an 3D accelerometer (±16g) and a 3D gyroscope (±2000 deg./s.) were attached at the athletes' ankles and the sacrum. IMU data were stored on an microSD card, and flight times were derived for each position by specific algorithms. An OptojumpNextTM system (OJ) served as reference with all devices collecting data at 1kHz. Jump heights were calculated from flight times, and results from all devices were compared by intraclass correlation (ICC) and Bland-Altman-Plots (BAP).
Results
Jump height derived from the IMU at the ankles showed a mean difference of 0.9cm and a maximum deviation of 4.2cm compared to OJ. For the IMU attached at the sacrum, a mean of 1.1cm as well as a maximum of 7.2cm were found. ICC between OJ and the IMUs were r=.995 for the ankles and r=.951 for the sacrum, respectively. Bland-Altman-Plots showed 95% limits of agreement in the range of 2.9cm to -1,2cm for the ankles and 6.8cm to -4.6cm for the sacrum.
Discussion
Results indicate that a placement of an IMU device at the ankle reveals jumping heights that are more accurate than placing the IMU at the sacrum. However, data from both positions are highly correlated to the reference measurement with mean differences of approximately 1cm. We assume that this accuracy is acceptable for the application in volleyball training. The placement at the sacrum might be more comfortable for athletes, and especially facilitates an automatic detection of jumping heights, because the identification of the first foot landing as well as the synchronization of the devices is not affordable. Further developments will focus on the optimization of algorithms and onboard data processing which will allow - in combination with wireless data transmission - to improve the quality of volleyball training by immediate feedback on spiking performance.

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A STUDY ON THE AUTOMATIC RECOGNITION OF ELECTRONIC RUNNING ROUTES: TAKING RUNNING TRACKS AS AN EXAMPLE

WANG, K.
NATIONAL TAIWAN SPORT UNIVERSITY

Introduction
Runners use an electronic device to track routes by recoding a set of GPS coordinates. These users not only share their routes on social media (Wang, 2014) but also use the data to match the stats of a virtual runner to compete with (Wang, 2015). In some cases, the pooling of similar routes facilitates the matching of data. In this regard, more and more running routes need to be recognized automatically on mobile devices.
Methods
Looped running tracks were selected for this study. To acquire the GPS data, we developed a smartphone app and invited runners on the selected tracks to join our project. A total of 33 pieces of data from runners on six tracks were collected. The classification and regression trees (C&RT) algorithm(Loh, 2011) was used to recognize and classify the routes. By collecting the GPS coordinates, we acquired the features of each track (e.g. perimeter, long axis and short axis), and utilized these features for route classification. We used 22 pieces of data as training samples and the other 11 pieces for testing. To better classify the results, a feature selection method(Guyon, & Elisseeff, 2003), or FSM, was used to select features to create the best model.
Results
The results showed that the said features (i.e. perimeter, long axis and short axis) could work independently to classify the routes. The accuracy of each test sample was 0.701, 0.8264, and 0.7331. The introduction of FSM and combination of two more features (i.e. long axis and short axis) increased the accuracy to 0.865. However, that value decreased to 0.8643 if we further added perimeter as a feature. We then used the difference between long and short axis as a feature for classification, and found that it functioned well. By including the long axis together for classification and recognition, the accuracy reached up to 0.9.
Discussion
Our analysis showed that the long axis, short axis, and their difference of an electronic running route served effectively to classify and recognize the route. App developers may refer to the results of this study for the function of cross-destination matching of running routes, and that of adding runners and virtual opponents as the elements of a real-world race.
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Contact
elverz@ms8.hinet.net

THE ANALYSIS OF SKI FRICTION USING KINEMATIC GNSS

MIYAMOTO, N., MORIMOTO, T., OKUSHI, K., MIURA, R., SUZUKI, A., HATAKEYAMA, N., MIYAMOTO, A.
TOHOKU UNIVERSITY

Introduction
Kinematic Global Navigation Satellite System (GNSS) realizes millimeter-accurate positioning. It has been used for sport science and kinesiology in ski (Supej, 2010; Miyamoto N., et al.,2016). Unlike camcorders, GNSS receivers must be attached to the measured subject, mostly attached on the body of athletes. Therefore, we have developed a compact and lightweight GNSS receiver named AT-H-02 with a post-processed kinematic mode.
The purpose of this paper is to analyze friction between snow and ski base during wax test. We estimated the coefficient of friction (COF) using the AT-H-02 based on the law of conservation of energy.
Methods
Portability is highly demanded for GNSS receivers for sports. The AT-H-02 with 78x38x18 cubic mm size and 69g weight meets the demand. We found the AT-H-02 to be 7 times smaller and 5 times lighter than another portable GNSS receiver GCX2 by SOKKIA Corporation. Static position analysis of the AT-H-02 results in 1.6mm and 3.0mm RMS errors in horizontal and vertical directions, respectively, which are less than 1/300 of conventional differential GPS receivers.
We performed wax test experiments to analyze ski friction at Nayoro in Japan on 18th December 2015. Five waxes made by Gallium Corporation including one high fluorine VIOLET named AXF30 and four base waxes VIOLET, PINK, BLUE, GREEN were used for analysis. We evaluate the ski friction in terms of the COF. Friction energy is calculated using GNSS positioning data and the law of conservation of energy. Then the COF is calculated by fitting the friction energy to the Stribeck curve.
Results
During wax test experiments at a slope of 10 degree angle and 31.5 meter long in cross country ski track, average positioning accuracy was 14mm and 21mm RMS errors in horizontal and vertical directions, respectively. At above 1 m/s velocity, the estimated COF of AXF30, VIOLET, PINK, BLUE, GREEN were 0.0145±0.00029, 0.0149±0.00004, 0.0156±0.00095, 0.0167 ±0.00055 and 0.0176±0.00037, respectively. The air and the snow temperature at the experimental field were 2.7 and -0.8 degree C, respectively. The snow was new and wet. Since AXF30 and VIOLET are for temperature between -4 and +3 degree C, their COF became smaller than other waxes. High fluorine AXF30 is better than VIOLET because the snow was wet and had water content. However, at low velocity of below 1m/s, we found that the COF of VIOLET and AXF30 became, on the contrary, worse than PINK, BLUE, GREEN.
Discussions

We consider that melting water for lubrication between snow and ski base did not generate sufficiently at low velocity for VIOLET and AXF30.

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THE PERFECT TRIATHLON SUIT: CONSIDERATION OF FACTORS INFLUENCING FUNCTIONAL ATTRIBUTES AND PERFORMANCE OF ATHLETES

WATSON, C., TROYNIKOV, O., NAWAZ, N.

RMIT UNIVERSITY

Introduction

The ironman discipline in international triathlon events is widely regarded to be one of the most physically arduous single-day sporting events in the world (1). These events are conducted all over the world in a wide array of environmental conditions. For athletes, along with equipment and footwear, choice of apparel is important for the best competitive performance over the ironman event distance which can typically take more than 12 hours to complete (2). For apparel, optimized support for physiological thermoregulatory function of the athlete is essential, and is a complex matter which is affected by his/her physiological outputs and the expected ambient conditions.

Methods

For this study, research was conducted across 7 key Ironman Championship locations (3) to determine the range of environmental conditions encountered by competing athletes (4). Controlled experimental conditions of 29°C and 75% relative humidity were selected as representative of conditions encountered during an Ironman event. The study used a 20 zone sweating thermal manikin to objectively evaluate a number of Ironman triathlon suits under the selected controlled ambient conditions, to determine their attributes relevant to the thermoregulatory function of the competing athlete. Two developed dynamic activity experimental protocols were established using the manikin; one to simulate a bike leg of the Ironman event, and the second to simulate a run leg of it. A dynamic experimental flow cycle of different heating and sweating phases was used to program the manikin to simulate the human metabolic and sweating activity conditions which would occur when an athlete is competing in each of these legs: heat flux and sweating rates for a male participant finishing in average time were used. Data of bike and run leg times for Ironman championship events (5) were used as a basis for the developed dynamic experimental protocol; and the manikin was dynamically programmed to appropriately simulate the physiological outputs.

Results

The experimental results demonstrate that the thermal resistance and water vapour resistance performance attributes of the triathlon suits were statistically significantly different. The results established that the combination of fibre composition; material construction and garment design are critical to its functional performance, and that garment and material requirements will vary depending on expected environmental conditions for the competition.

Discussion

This study provides designers and textile manufacturers with valuable insights into the importance of material composition and apparel design to provide optimal thermoregulatory support to Ironman triathletes.

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Oral presentations

OP-PM23 Acute effects of HIT

DIFFERENT MODES OF EXERCISE: LESSONS TO HIGH INTENSITY INTERVAL TRAINING

SOUSA, A.1,2, FERNANDES, R.2, VILAS-BOAS, J.P.2, FIGUEIREDO, P.3

1: ESCOLA SUPERIOR DE DESPORTO E LAZER , INSTITUTO POLITÉCNICO DE VIANA DO CASTELO , MELGAÇO, PORTUGAL; 2: CIFI2D, FACULTY OF SPORT, UNIVERSITY OF PORTO, PORTUGAL

Introduction

The time sustained at the exercise intensity corresponding to VO2max (Tlim) provides information on both aerobic and anaerobic fitness, helping monitoring the training effects and prescribing training loads. In fact, the use of a fraction of Tlim (e.g. 60%) has been used for stablishing high intensity interval training (HIIT) for endurance athletes (Hill and Rowel, 1996). Considering the similar values of Tlim among different exercises modes (Sousa et al., 2015), it is expected that a fraction of this intensity would be similar. However, the temporal aspects of the VO2 response of Tlim are poorly understood in different exercise modes, still being unanswered whether 60% (or other percentages) of Tlim would led to similar ventilatory responses.

Methods

Forty five highly trained competitive male swimmers (n=11), rowers (n=13), runners (n=10) and cyclists (n=11) (mean ± SD; age: 23.7 ± 3.1 yrs, height: 1.77 ± 0.05 m and body mass: 68.9 ± 3.4 kg) performed two protocols: (i) an intermittent incremental protocol until exhaustion for VO2max and corresponding velocity (vVO2max) or power (wVO2max) assessment, and (ii) a single square-wave transition exercise from rest to the previously determined vVO2max or wVO2max intensities until volitional exhaustion to assess Tlim. Cardiopulmonary parameters were assessed breath by breath (averaged 5s) using a portable and telemetric gas analyser (K4b2, Cosmed, Italy). The percentage of VO2max at 30 and 60 s time period (t30 and t60) and at 50, 60 and 70% of Tlim (t50%, t60% and t70%) were considered for analysis.

Results
VO2 responses during all square-wave transitions were not different in-between exercise modes for any of the temporal parameters considered (t30: ~77%; t60: ~90%; t60%: ~97% and t70%: ~100%), with the exception of t50% that was ~6% higher in rowing compared with cycling (97.70±2.90 vs. 92.40±5.69%, respectively: p=0.013, η2=0.23).
Discussion
Considering that an optimal improvement in cardiorespiratory fitness performance relays on training at intensities corresponding of 90-100% of VO2max, the current data support a physiological rationale for prescription of HITT at VO2max intensity for 50 ≤ Tlim ≤ 70% durations. Moreover, the similar ventilatory responses at 60 and 70% of Tlim found in-between exercise modes, suggests that these intensities could be used indifferently in each exercise mode.
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Contact
a.catarina.sousa@esdl.ipvc.pt

HIGH-INTENSITY INTERMITTENT TRAINING VERSUS MODERATE-INTENSITY INTERMITTENT TRAINING: DIFFERENCES IN THE ACUTE RESPONSE OF HEART RATE VARIABILITY IN FEMALES

JIMÉNEZ-PAVÓN, D., ANSOAR-VARELA, R., PONCE-GONZÁLEZ, J.G., GRAO-CRUCES, A., CAMILETTI-MOIRÓN, D., CASTRO-PIÑERO, J., CUENCA-GARCÍA, M., CARBONELL-BAEZA, A.
UNIVERSITY OF CÁDIZ

Introduction
Heart rate variability (HRV) is widely used with many applications based on its relation with the role of autonomous central system in exercise (McCraty and Shaffer, 2015). High-intensity intermittent training (HIIT) has been suggested as a relevant activator of the sympathetic nervous system influencing HRV. We sought to analyse the effect of HIIT compare with moderate intensity intermittent training (MIIT) (Little et al, 2010) on the acute HRV response after exercise and 24h later in adult females.
Methods
Six active females (37.7 ±3.0 years old) performed a maximal cycle ergometer test (week 1). Then, they underwent two training sessions with identical volume and density but different intensity (HIIT and MIIT) one week apart and in random order (weeks 2 and 3). HRV was recorded during a 10-minutes period laying on back before and after exercise, and after 24h of recovery. Temporal (PNN50) and frequency (LFnu, HFnu and LF/HF) domains were analysed (AHA and ESC, 1996). The inter and intra training differences were studied.
Results
There were significant differences in PNN50, LFnu and LF/HF (all, $p<0.05$) after the training session reporting a lower HRV in HIIT but not in MIIT. There were no significant changes after 24h of recovery compared with baseline assessment in HIIT neither MIIT. A higher activation of sympathetic nervous system was found in HIIT compared with MIIT sessions as indicated by the significant lower values in PNN50 and HFnu ($p<0.05$); and the higher LFnu and LF/HF after HIIT ($p<0.05$).
Discussion
In adult females a HIIT session implies an acute reduction of HRV but not with lower intensity (MIIT). The indicators of sympathetic activity (LFnu and LF/HF) suggest a higher influence in the acute response of HIIT versus MIIT (Iglesias-Soler et al., 2014). Our findings suggest that HRV is able to discriminate among the acute sympathetic nervous system activity at different intensities, thus HRV may be a useful tool to assess and quantify training load.
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Contact
david.jimenez@uca.es; ana.carbonell@uca.es

ENERGETIC CONTRIBUTION TO SMALL-SIDED SOCCER GAMES WITH DIFFFERENT GAME DURATION AND NUMBER OF PLAYERS

OH, S., HARTMANN, U.
INSTITUTE OF MOVEMENT AND TRAINING SCIENCE II

Introduction
Most previous studies evaluated the energetic contribution (EC) in small-sided soccer games (SSGs) with different number of players using only heart rate and blood lactate concentration (BLa) (Hill-Haas et al., 2009). But in order to calculate the different shares of EC, the determination of oxygen uptake (VO2) is necessary. Aim of this study is to investigate EC of SSGs according to a changed number of players.
Methods
Twelve U16 elite junior soccer players (15.3 ± 0.7 yrs, 62.3 ± 7.4 kg, 172.9 ± 5.7 cm) performed 3 different game formats, 2 vs. 2 (2SG), 4 vs. 4 (4SG) and 6 vs. 6 (6SG) on the constant relative pitch size per player separated by two or three days. 4SG and 6SG were played 4 min, while 2SG was performed 2 min. During and after the playing time VO2 and BLa were measured by portable gas analyser (MetaMax 3B) and BLa analyser (BIOSEN S_line). To ensure the phase of fast and slow components the VO2 was measured for 6 min after each SSGs. The amount of absolute energy produced were calculated based on the accumulated VO2 above rest during SSG (aerobic [WAER]), fast component of the post-exercise VO2 (anaerobic alactic [WPCr]), maximum net accumulation of BLa (anaerobic lactic [WBLa]) (Beneke et al., 2004). The percentage of each energy system was calculated from total energy supply. The data were analysed using a one way ANOVA with repeated measures.

Results
WAER during 2SG (69.2 ± 6.8 %) was significantly lower ($p < 0.01$) than 4SG (84.7 ± 3.0 %) and 6SG (87.4 ± 2.8 %), while WPCr and WBLa during 2SG (22.3 ± 3.5 % and 8.5 ± 5.1 %, respectively) was significantly greater ($p < 0.05$) than 4SG (12.4 ± 2.7 % and 2.9 ± 0.6 %, respectively) and 6SG (10.3 ± 2.9 % and 2.4 ± 1.0 %, respectively). WAER during 4SG was significantly lower ($p < 0.05$) than 6SG, while WPCr during 4SG was significantly greater ($p < 0.05$) than 6SG.
Discussion
The present study demonstrated that the energy supply for all game formats with different duration relies mainly on the aerobic system with more than 70% of total energy supply for 2SG, and 85% for 4SG and 6SG. The glycolytic share has very small influence on energy supply with <9% for 2SG and <3% for 4SG and 6SG. A similar share of EC between 4SG and 6SG for the same game duration was found. These results of EC regarding the number of players and game duration should be take into account for further training planning.
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Contact
inehwan@gmail.com

PHYSIOLOGICAL, PERCEPTUAL AND PERFORMANCE RESPONSES ASSOCIATED WITH SELF-SELECTED VERSUS STANDARDIZED RECOVERY PERIODS DURING A REPEATED SPRINT PROTOCOL IN ELITE YOUTH FOOTBALL PLAYERS

GIBSON, N., BROWNSTEIN, C., BALL, D., TWIST, C.
HERIOT-WATT UNIVERSITY

Introduction
The aim of the study was to examine the physiological and perceptual responses of youth footballers to a repeated sprint protocol employing standardized and self-selected recovery.
Methods:
Eleven male participants (13.7 ± 1.1 years) performed a repeated sprint assessment comprising 10 x 30 m efforts. Employing a randomized crossover design, repeated sprints were performed using 30 s and self-selected recovery periods. In the self-selected recovery trial participants were instructed to allow sufficient recovery to maintain a maximal effort in each sprint. Heart rate was monitored continuously with ratings of perceived exertion (RPE) and lower body muscle power measured 2 min after the final sprint. The concentration of blood lactate was measured at 2, 5 and 7 minutes post sprinting. Magnitude of effects were reported using effect size (ES) statistics ± 90% confidence interval and percentage differences.
Results
Self-selected recovery resulted in most likely shorter recovery times (57.7%; ES 1.55 ± 0.5), a most likely increase in percentage decrement (65%; ES 0.36 ± 0.21), very likely lower heart rate recovery (-58.9%; ES -1.10 ± 0.72), and likely higher blood lactate concentration (21.5%; ES 0.9 ± 0.7). Differences in lower body power and RPE were unclear.
Discussion
Whilst self-selected recovery periods compromised repeated sprint performance, physiological load was higher than when a standardised 30s recovery was used. Repeated sprinting using self-selected recovery periods may represent a useful training modality in circumstances where the aim is to maximise the physiological response in elite level youth football players.

EFFECT OF HIGH-INTENSITY INTERVAL TRAINING ON GLUCOREGULATORY HORMONES : EFFECT OF RECOVERY MODE

BEN ABDERRAHMAN, A., PRIOUX, J., RHIBI, F., BEN-ATTIA, M., ZOUHAL, H.
MOVEMENT, SPORT, HEALTH AND SCIENCES LABORATORY (M2S), UNIVERSITY OF RENNES 2

Introduction
Catecholamines are well known to stimulate the regulation of glucose metabolism at rest and maximal exercise (Kjaer, 1992; Marliss and Vranic, 2002). However, changes in theses hormones are altered by training status and recovery mode (Abderrahmen et al. 2013). The aim of this study was to examine the effects of recovery mode and high intensity interval training (HIIT) on glucoregulatory hormone in responses to maximal exercise in younger (20years) athletes.
Methods
24 volunteered male participated in this study. All subjects were assigned in one of the three groups: A control group (CG, n=6), and two high-intensity interval trained groups: Intermittent exercise (30s) with active (ARG, n=9) or passive recovery (PRG, n=9). All subjects were well-trained but none was specialized in middle- and long-distance running and never practiced 30s-30s interval exercise before this study. Trained groups performed a high-intensity interval training program (3times/week) during 7 weeks. Before and after HIIT, participants undergo a maximal graded test. Plasma catecholamines, glucose, insulin, and cortisol were determined at rest, at the end of exercise (Exemax) and after 10 and 30 minutes of recovery.
Results
Training induced significant ($p<0.05$) changes in ARG: an increase of VO2max and MAV along with a significant ($p<0.05$) increase of A and NA at the end of Exemax. Insulin responses did not differ between trained groups and between control group. No significant changes in basal cortisol levels among the three groups before and after HIIT. However, during the 30th minutes of recovery after Exemax , cortisol level were significantly ($p<0.05$) higher in ARG when compared to other groups.
Coclusion
In conclusion, in order to improve VO2max and VMA, it seems that active recovery mode is most recommended in intermittent training type comparing to passive recovery mode. Active recovery mode may be a powerful stimulus to adrenal medulla activity during maximal exercise. While insulin and glucose levels at rest and in response to exercise were similar between groups, cortisol levels were significantly higher in ARG during recovery. Hence, it seems that active recovery mode improve the hepatic glucose production during recovery via cortisol stimulation.
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THE "GRAVITY-FACTOR" FOR EXERCISE IN SPACE: IS HIGH INTENSITY TRAINING IN SPACE COMPARABLE TO THAT ON EARTH?

PETERSEN, N., GREEN, D.A., LEO, A., MESTER, J., PARMITANO, L., WEERTS, G.

ESA-EUROPEAN ASTRONAUT CENTRE

Introduction
When prescribing exercise programmes for astronauts in weightlessness, it is unknown whether a 'gravity factor' should be accounted for when transferring high intensity protocols known to be effective on Earth, onto the International Space Station (ISS) to mitigate cardiorespiratory deconditioning. Whilst on Earth, heart rate (HR) is linearly related to running speed, whereas in microgravity self-selected speeds tend to be faster, even though loading equivalent to 70-80% bodyweight during treadmill running is provided. Such treadmill running is typically performed 4-6 times per week on the ISS as part of the ESA countermeasure programme which is structured into 3 periods: adaptation (Phase 1), microgravity (Phase 2), and preparation for landing (Phase 3). Data from an astronaut-athlete performing treadmill exercise to their maximal capacity on ISS, and in preparation for an Iron Man race post-flight provides an unique opportunity to compare the relationship between 'maximal training' running speed and HR in microgravity, and on Earth.
Methods
A male ISS crewmember gave written informed consent to compare in-flight exercise data in space and on Earth. Speed and heart rate were compared from 41 bouts of self-selected treadmill running on Earth and 31 on the ISS as part of a continuous running protocol. The relationship between speed and HR was evaluated on Earth, across the mission, and within each phase via linear regression with generated slopes compared with t-value calculations.
Results
Speed in microgravity was consistently higher than on Earth, although the Speed/HR relationship on Earth ($R = 0.414$; $p = 0.007$) and across ISS Phase 1 and 2 were positively linearly related ($R = 0.501$; $p = 0.004$). However, Phase 1 (speed < 18 km/h; $R = 0.001$; $p = 0.998$) and Phase 2 (speed > 18 km/h; $R = -0.187$; $p = 0.381$) data formed two distinct clusters. Thus, whilst in neither phase a significant speed/HR correlation was observed, the negative slope in P2 differed significantly ($p<0.001$) from the positive one seen on Earth.
Discussion
Increased running speed was observed in microgravity, with completion of the transition phase leading to speeds in excess of 18 km/h. Interestingly, whilst speeds in Phase 1 had no relationship (no obvious progression despite ongoing adaption) between speed and HR presumably due to the adaptation to running in microgravity, phase 2 data had a negative slope despite no effect of time with some evidence that the treadmill may have limited achieved speeds. Thus, this unique data suggests that following an adaptation phase crew members when evaluating crew members exercising at high intensity levels that not only a "gravity factor" but also a "technical factor" may need to be accounted for.

Invited symposia

IS-SH03 Getting the moves: bodily learning in three movement cultures

INCARNATING A KINESTHETIC CULTURE: ON THE EMBODIMENT OF CONTEMPORARY DANCE

BASSETTI, C.

UNIVERSITY OF TRENTO

Like other bodily activities, dance constitutes "one of the terrains in which the problem of the relationships between theory and practice, and between body and language, too, is sharpest" (Bourdieu 1987). Dance knowledge is transmitted multimodally (Bassetti 2009a), though mostly body-to-body (Hahn 2007), and acquired through a dialectic of mimesis and differentiation (Wacquant 2000; cf. Bassetti 2009b). The learning process results in changing one's habitus, one's structured and structuring dispositions towards action, thinking, and perception (Bourdieu 1977, 1980), and it does so at the level of the lived body (Merleau-Ponty 1942, 1945), mostly behind reflexive consciousness (Bourdieu 1987). "To know a body technique is to acquire a new way of knowing, understanding and relating to the world and perhaps also to oneself" (Crossley 2015) —that is, learning involves (practices of) corporeal, experiential, and identitarian transformation.
This contribution focuses on what is needed for any dance performance to be (properly) enacted, on the abilities that are consequently required to (aspiring) dancers, and the practices they exploit in order to succeed. I consider the components and characteristics of that learning process which leads to the embodiment of the dancing habitus, to the incarnation of a particular kinesthetic culture, that of contemporary dance.
The paper is based on the multi-sited (self-)ethnography I carried out on the world of theatrical dance. Data include interviews, field notes and videorecordings. For over two years, I observed two Italian companies and the related schools daily, and on occasion, over a dozen international companies. Furthermore, for the first time in my life, I participated in dance classes and shows as a complete member, in order to understand the meaning of becoming and being a dancer, to acquire a practical, visceral mastery.
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VIS-ABILITY: HOW TO LEARN MARTIAL-ARTS

SCHINDLER, L.
UNIVERSITY OF VIENNA

Common sense has it that teaching often benefits from using visual methods. This is in no way to be contradicted, but it overlooks an important moment of learning: Seeing is not mere conceiving of what is being displayed, but it is culturally shaped, as different studies have shown. One of the most prominent studies is Charles Goodwins (1994) „Professional Vision" that points out that professionally different views are not merely based on cognitive, but on embodied knowledge.
The paper tackles this discussion with an interest in empirically understand how this effects learning. Based on an ethnographic study of teaching and learning in a martial arts club, it asks how the embodied knowledge of the martial arts is passed over to the students. It finds that in the beginning of learning, they experience severe difficulties of grasping what has been displayed to them well enough to repeat it in the following exercise. What they lack is a practice trained vis-ability. This result might also be interesting for learning in other contexts: What kind of vis-ability do the applied visual methods require?

BECOMING A BALLET BODY: RECONFIGURING DISTRIBUTED CORPOREALITIES

MÜLLER, S.M.
EBERHARD KARLS UNIVERSITY TUEBINGEN

Anybody having had the briefest contact with ballet training will be able to recall the strict spatial order – bodies lined up neatly at a barre – and the synchronous movement successions performed in a serious, solemn manner accompanied by piano music. Based on movement, ballet is dependent on highly trained athletic bodies with specific, very complex abilities for them to serve as the 'instrument' of a dancer and 'material' for the choreographer to create artworks. But in order to be able to work, bodies must be worked on. Practical training is situated alongside the choreographic rehearsals in the framework of ballet class. Here, bodies are intentionally involved in and kept in the practice in concerted self-instrumentation. They are reconstructed to be ballet bodies.
This paper focuses on the reconfiguration regarding ballet as a body technique. Taking on a praxeological, posthumanist perspective, it is concerned with the body as a cultural artifact actively participating in and being shaped by learning practices. Based on empirical data I show how the everyday unit of 'the body' is dissected in training, balletic differential acts performatively 'cutting out' multiple bodily participants. The paper shows not only how exactly the mastery of balletic hexis is produced, but also that the taken-for-granted body as a 'stable entity' has to be taken as a practical accomplishment.

Oral presentations

OP-SH10 Curriculum Development

A RANDOMISED CONTROL TRIAL TO ASSESS THE IMPACT OF PHYSICAL EDUCATION TRAINING UPON PHYSICAL LITERACY OUTCOMES

WILLIAMS, T.1, WADE, M.1,2, MANN, S.1,3
UKACTIVE RESEARCH INSTITUTE

Introduction
Physical literacy is the ability to use a range of fundamental movement skills in a competent manner, with the capacity to confidently apply them in a range of settings, which can lead to sustained involvement in sport and physical activity. Physically literate children are able to perform movement skills such as hopping, climbing and catching. This can lead to improvements in agility, balance and coordination at levels appropriate to their capabilities. Physical literacy is fundamental to the development of an active lifestyle. This study is a randomised controlled trial that aimed to assess the impact of teacher training programme designed to help teachers elicit better physical literacy related outcomes from physical education (PE) provision within a primary school setting.
Method
Participants (n=136) were children aged 9-10 from 8 primary schools located in the 20% most deprived areas of the county of Buckinghamshire (UK). PE specialists from the County Sport Partnership developed resources and trained teachers from randomly assigned schools in their application. Schools not receiving the intervention will receive it during 2017. Measures were taken from the 'Physical Literacy Assessment for Youth' methodology developed in Canada, and included children completing locomotion, throwing, kicking, and balance exercises. These were scored by an assessor blind to which schools had received the intervention. Pre-Post measures were collected 6 months apart during the same academic year.
Results
Data highlight significant increases in physical literacy across all participants ($p<0.05$). One way ANCOVA, used to determine differences in the post-test means after accounting for pre-test values for the intervention and control schools reveal the average (mean diff.= 0.55; std. error= 0.16) and sum (mean diff.= 0.55; std. error= 0.16) physical literacy scores improved to a significantly (average ($F(1,135) = 12.39$, $p=.001$), sum ($F(1,135) = 12.39$, $p=.001$)) greater extent in intervention schools than control. Analysis of specific components highlight kicking and balance as areas of strength, whilst running (specifically backwards) and throwing are areas for development.
Discussion
The teacher training programme elicited significantly greater improvements in physical literacy scores than maturation alone (control). Findings suggest that specific PE training for primary school teachers, accompanied by dedicated resources, may be an effective mechanism for increasing physical literacy amongst primary school age children.

A COMBINED MOVEMENT AND STORYTELLING INTERVENTION ENHANCES MOTOR COMPETENCE AND LANGUAGE IN PRESCHOOLERS TO A GREATER EXTENT THAN MOVEMENT OR STORYTELLING ALONE.

DUNCAN, M., CUNNINGHAM, A., EYRE, E.

COVENTRY UNIVERSITY

Introduction
Early motor skill development may have an important role in promoting physical activity (PA) during childhood, and across the lifespan (Loprinzi, et al., 2015). Researchers have also suggested that PA, through motor development, may also enhance academic achievement in children. Despite this few intervention studies are available which examine how movement interventions might influence motor development and academic achievement in early childhood. This study examined the effect of a combined movement and storytelling intervention, compared to a movement only or storytelling only intervention on motor competence and language ability in British Preschoolers.
Methods
Following ethical approval and parental informed consent, 74 preschoolers (39 boys; 35 girls aged 3-4 years) participated in quasi-randomised controlled study. Preschoolers from 3 nurseries were randomly allocated to one of 3, 6 week interventions, 1) a combined movement and storytelling intervention, 2) a movement only intervention or 3) a storytelling only intervention. Pre and post, 4 motor skills: run, jump, throw, and catch were assessed the Test of Gross Motor Development-2. The scores for all the skills were then summed to create a total motor competence score (0-16). Language ability was assessed using the naming vocabulary subscale (T-Scores) of the British Ability Scales for preschoolers.
Results
Results from a 2(pre vs post) X 3(group) way repeated measures ANOVA revealed a significant pre vs post X group interaction for motor competence (P = .0001) and language ability (P = .0001). Motor competence significantly increased pre to post for all the groups with the magnitude of change being greater for the combined movement and storytelling group (Δ=4.86) compared to the movement only (Δ=2.88) or storytelling only (Δ=1.77) groups. Likewise, language ability significantly increased pre to post for all the groups with the magnitude of change being greater for the combined movement and storytelling group (Δ=8.7) compared to the movement only (Δ=3.1) or storytelling only (Δ=1) groups.
Discussion
These results suggest that a short-term combined movement and storytelling intervention is superior to either a movement only or storytelling only intervention in enhancing both motor competence and language ability in British preschoolers. Integrating cognitive challenge via storytelling at the same time as movement training over a 6 week period appears to augment physical and cognitive development in pre-schoolers in a manner that is in excess of changes expected from normal development in 3-4 year olds.
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Contact
aa8396@coventry.ac.uk

DIFFERENCES IN CHILDREN'S PERCEIVED NEGATIVE EXPERIENCES IN PHYSICAL EDUCATION – THE ROLE OF BODY MASS INDEX AND MOTOR ABILITY

MÖHWALD, A., GRIMMINGER-SEIDENSTICKER, E., KORTE, J.

TU DORTMUND UNIVERSITY (GERMANY)

Introduction
Physical Education (PE) is a unique school subject where the body is in focus: Students have to perform, compete and act using their bodies. Deviations from physical as well as sportive "standard values" may lead to negative experiences in PE (Trout & Gaber, 2009). There is empirical evidence showing that overweight children have inferior motor abilities compared to their normal weight classmates. Moreover, children with lower motor abilities have a lower self-concept and are more often considered as outsiders (Grimminger, 2013). Therefore, PE may be experienced differently from children with diverse body mass index (BMI) and with different motor abilities.
Methods
In total, N = 765 elementary school students with a mean age of 9.2 years (SD=.79) took part in this study. Amongst others, students filled out a questionnaire assessing "concerns regarding PE" and "experiences of discriminations by peers". Their physical fitness was measured by the "German Motor Ability Test" (Bös et al., 2009). Children were measured and weighted in order to calculate children's BMI reliably. For further analyses children were divided into following subgroups: "normal weight-low abilities" (n = 253; 33.3 %), "normal weight-high abilities" (n = 345; 45.5 %), "overweight-low abilities" (n = 127; 16.7 %), and "overweight-high abilities" (n=34; 4.5 %).
Results
Analyses of variance show significant differences in both scales "concerns regarding PE" and "experienced discriminations through peers" between the four subgroups, $F(3,724) = 15.67$, $p < .001$ resp. $F(3,732) = 12.44$, $p < .001$). Post-hoc tests indicate that normal weight students with high motor abilities have significantly less worries about PE and are discriminated less by peers than both groups with low motor abilities. There are no significant differences between normal weight and overweight students with high motor abilities.
Discussion
Analyses indicate that rather motor abilities than physical constitution of children are related to negative experiences in PE. Both groups with higher motor abilities have –independently of their BMI– less concerns about PE and experience less discrimination through peers. The promotion of students' motor abilities seems to be a crucial element for a holistic development of all children.
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BLENDED-LEARNING: CREATION OF AN INTERACTIVE LEARNING UNIT OF RUNNING

NAGL, J., HOFFMANN, M., STEIN, T.

KARLSRUHE INSTITUTE OF TECHNOLOGY

As an authentic and extracurricular place of learning student labs gained in importance over the last years. Primary objective of student labs is to arouse interest for natural and engi-neering sciences as well as to impart knowledge to students. Student labs are established, for example at universities or big companies, to let students carry out experiments by them-selves to gain knowledge (Haupt et al, 2013). "School goes BioMotion" (SgB) is a student lab at Karlsruhe Institute of Technology enabling students to conduct biomechanical and physiological experiments. The lab will provide five different learning units that are offered within a blended learning approach. The purpose of this contribution is to present the student lab SgB using the example of the new interactive learning unit of running.
The online part is divided into four chapters which include the required fundamentals of physics and biology as well as an introduction to biomechanics. The learning content of each chapter is prepared didactically and presented on an easily understandable level. By using sport specific motor skills as typical examples, student's experiences are taken up to foster the consolidation of the new contents. The students can choose the order of the chapters by themselves. Furthermore the e-learning part takes individual learning speed and previous knowledge into account. It ensures that all students have the same prior knowledge when the class visits the student lab. At the end of the e-learning part the students take a test consisting of ten questions, which are selected from a question pool, and are provided with feedback about their learning progress.
The following face-to-face part opens with a short introduction, explaining physical parameters necessary to understand the fundamental biomechanics of running. Afterwards, the class is split up into two groups. During the processing phase the first group investigates the kinematics while the second group investigates the dynamic parameters for various running speeds. The groups conduct the experiments by themselves with the help of a manual. In a next step each group is divided in half and provided with prepared data for analysis in small-group work. Subsequently the kinematic and the dynamic group compare and discuss their results for various running speeds. In the following presentation phase the groups present their results, before the module supervisor secures the progress (cf. Nagl, 2016).
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Contact
johannes.nagl@kit.edu

HEALTH.EDU – SPORT-RELATED HEALTH COMPETENCE OF PUPILS IN SECONDARY SCHOOLS

HEß, K.1, STROBL, H.1, TÖPFER, C.2, SYGUSCH, R.2, TITTLBACH, S.1

1: UBT (BAYREUTH, GERMANY), 2: FAU (ERLANGEN-NÜRNBERG, GERMANY)

Introduction
An important aim in Physical Education (PE) is to develop pupils' sport-related health competence (SRHC), which means they can take over responsibility for their own health and are able to practise sports autonomously in a health enhancing manner. However, it is important that PE teachers address on these health aspects in PE lessons. On this basis, the purpose of the Health.edu study, granted by Germany's Federal Ministry of Education and Research (01EL1421D), is to improve pupils' SRHC by a participatory approach that consists of a cooperative planning process.
Methods
A one year cooperative planning process was carried out at four intervention schools. About five meetings were hold at each school, where different stakeholders (PE teachers, pupils, principals, scientists) conceptualize and evaluate PE lessons regarding the promotion of SRHC. Four other schools constituted the control group and carried out their normal PE lessons. SRHC was measured at the beginning and the end of the school year 2015/2016 by a standardized paper and pencil test designed to assess SRHC (Töpfer & Sygusch, 2016). The total pre-post-sample includes 232 pupils with the age range of 11-17 years (M=14.66, SD=1.27; 60% intervention group, 54% female). Data is analyzed by a one-way repeated-measure ANOVA with the between-subject factor intervention/control school.
Results
Results show a significant improvement of SRHC for the total sample between both times of measurement (F1, 232=4.984; p=.027; η^2=.022). However, there is no significant interaction for SRHC-improvement between pupils in the control and intervention group (F1, 232=.765; p=.383; η^2=.003). Nevertheless, when excluding one intervention school from analysis, where the intervention did not work well because of missing teachers' health awareness and commitment, the interaction SRHC * intervention/control group gets significant (F1, 232=3.927; p=.049; η^2=.021).
Discussion
The intervention is successful in improving pupils' SRHC at three schools. However, the results indicate that intervention success in cooperative planning processes depends largely on the commitment of PE teachers, as so-called trigger points. These findings match with Hattie (2008) who found out, that the teacher is the most important variable to predict pupils' learning.
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Contact
Katharina Heß [katharina.hess@uni-bayreuth.de]

STUDYING SPORTS SCIENCE: STUDY PROJECTS AS A WAY OF TEACHING AND LEARNING

FRITSCHEN, M., KLEINE, T., WASTL, P.

BERGISCHE UNIVERSITÄT WUPPERTAL

Introduction

In the course of Bologna's academic reform study projects have become more and more popular not only with universities' bachelor and master degrees but also with studies of sports science to improve the link between theory and practice. This way of teaching and learning seems to be more activity-oriented. It may even help students to enhance their autonomy. However, there are divergent understandings of what constitutes a study pro-ject and what educational objectives and competence expectations are associated with it (Gudjons, 2008). Our research project (SPORTFABIK) looks into this problem – with re-gard to PE teachers' higher education – and focuses on framing study projects in differ-ent disciplines of sports science (Fritschen, Kleine & Wastl, 2017).

Methods

A qualitative approach has been chosen to reveal the different ideas on study projects. In this evaluation the view of academic teaching staff is complemented by the perspective of current and former students as well as project partners (e.g. school teachers). After compiling theoretic ideas about projects at universities (e.g. Schneider & MustafiC, 2015), an interview guide was developed to conduct focussed interviews (Merton & Kendall, 1956). Going by nine interviews a theoretic satiation seemed to be achieved as far as the select-ed sports science institute is concerned. The data was researched by means of the reduc-tive content analysis (Mayring, 2015) and related to the syllabi.

Results and Discussion

The different disciplines of sports science seem to vary in the questions "What kind of practice are study projects related to?" and "What competences are the students to achieve?" as there are several reference points (e.g. school or workout studios) to be found. After analyzing the differences this presentation gives rise to the central question in which way the various competences may be combined. Therefore it is discussed to which extent differing views of the scientific discipline, teaching methodology and educa-tional science can be connected to establish, for example, general guidelines for study projects.

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Contact

fritschen@uni-wuppertal.de, tor@uni-wuppertal.de, wastl@uni-wuppertal.de

Friday, July 7th, 2017

08:00 - 09:30

Invited symposia

IS-PM02 EXERCISE AND THE BRAIN

EXERCISE, NEUROTRANSMISSION & NEUROGENESIS.

MEEUSEN, R.
VRIJE UNIVERSITEIT BRUSSEL

Exercise has an powerful influence on the brain. It is now well established that exercise will have a positive effect on brain health. Physical exercise can preserve cognitive function in elderly populations, promote functional recovery after central nervous system (CNS) traumatic injury, and induce neurogenesis in the adult CNS. Physical activity also increases trophic factor production in select regions of the brain. It is known that exercise increases brain neurotransmission and that repeated exercise (training) will influence baseline neurotransmitter release. Brain-derived neurotrophic factor (BDNF) is a crucial effector of experience-dependent plasticity. It is a neurotrophin that acts as a regulator of the survival, growth, and differentiation of neurons.
Physical activity and, in particular, acute exercise and training seem to be key interventions to trigger the processes through which neurotrophins mediate energy metabolism and, in turn, neural plasticity. In search of mechanisms underlying plasticity and brain health, exercise is known to induce a cascade of molecular and cellular processes that support (brain) plasticity. BDNF could play a crucial role in these induced mechanisms. Therefore, since the early nineties, studies started to investigate the effects of physical activity, acute exercise and/or training on levels of BDNF.
We will provide an overview of the studies we performed on effect of physical activity on neurotransmission, thermoregulation and indicators of neurogenesis such as BDNF.

FROM SPACE TO SCHOOL - NEURO-ENHANCEMENT THROUGH EXERCISE

SCHNEIDER, S.
GERMAN SPORT UNIVERSITY COLOGNE

Living in extreme environments is accompanied by a number of physiological (e.g. weightlessness) and psychological (e.g. confinement) stressors. Whereas the positive impact of exercise in space on the cardiovascular and musculoskeletal system is well documented, recent research also shows a beneficial effect of exercise on brain cortical activity, cognitive function and mood, all leading to improved mission success and safety. A transfer of these findings into everyday life (e.g. school sport, workplace, health promotion) emphasises the importance of regular physical activity for brain health and further supports the role of physical activity and a healthy lifestyle.

RELATIONSHIP BETWEEN COGNITION, ANTIOXIDANT DEFENCE SYSTEM AND VASCULAR FUNCTION: RATIONALE FOR EXERCISE INTERVENTIONS IN ADVANCED AGE

POLIDORI, M.C., ROSSI, A., WEIGERT, H., GERGER, P., STAHL, W., SCHNEIDER, S.
UNIVERSITY HOSPITAL OF COLOGNE

Vascular pathology has proven to play a major role in neurodegenerative processes associated with age-associated cognitive impairment. The cerebral changes associated with mild cognitive impairment (MCI), a clinical entity known to precede Alzheimer's dementia (AD), are likely to start several years prior to the onset of pathological scores at neuropsychological tests. During the years preceding clinically objectivable MCI, a critical threshold of cerebral hypoperfusion may be reached in advanced age and in the presence of vascular risk factors. Several studies suggest that brain hypoperfusion and vascular atherosclerotic burden might evoke a cascade of metabolic and oxidative stress-related events able to induce clinically manifest cognitive changes and, longitudinally, dementia. By promoting vascular tone and homeostasis, physical exercise is known to represent a strong lifestyle protective factor against neurodegeneration. However, the studies conducted so far have not taken into account the systemic, multifactorial nature of aging, neurodegeneration, lifestyle and physical conditioning, so that the majority of the results on the topic are rather frustrating. The present work will summarize knowledge showing the reciprocal relationships between exercise, vascular/endothelial function, micronutrient defence of the organism and cognitive reserve. The enormous clinical and socioeconomical implications of preventive actions against cognitive impairment with and without dementia in advanced age will be highlighted.

Oral presentations

OP-PM44 Effects of caffeine, tyrosine and creatine on performance

THE EFFECT OF CARBOHYDRATE AND CAFFEINE INGESTION ON INTERMITTENT SPRINT CYCLING IN THE HEAT

ROSS, C., OXFORD, S., CLARKE, N.D.
COVENTRY UNIVERSITY

Introduction

In normothermic conditions the individual and combined ingestion of caffeine or carbohydrate has been shown to have a performance benefit on intermittent high intensity activity (Gant et al., 2010). However, few studies to date have investigated co-ingestion of carbohydrate and caffeine in the heat. Therefore, the aim of this study was to investigate the effect of caffeine and carbohydrate ingestion on intermittent sprint cycling performance in the heat.
Methods
Twelve healthy trained, male team-sport athletes (age 29 ± 6 yr, mass 82.0 ± 6.3 kg, height 180.4 ± 6.5cm) completed four randomly assigned trials; placebo (water 25oC; PLA), caffeine (5 mg.kg-1; CAF), carbohydrates (6%; CHO), or caffeine and carbohydrate (5 mg.kg-1 and 6% respectively; C+C). All solutions (6.8 g.kg-1 of BM) were flavoured with orange cordial. Subjects then completed the 36-min intermittent sprint protocol (ISP) of: 18 x 4-s maximal sprints in a climate chamber (37.0 ± 1.1oC, Humidity 38.0 ± 1.9%). Each 4-s sprint is followed by 116-s of active recovery. Blood glucose, lactate, RPE, thermal sensation and thermal comfort were collected. Peak and mean power from the 18 sprints was used to calculate performance decrement.
Results
A repeated measures ANOVA was used and found no significant difference between conditions for either mean peak power (highest mean of 4s sprint) ($p = 0.194$, Peta2 = 0.135, PLA 1105 ± 259W, CAF 1151 ± 234W, CHO 1117 ± 249W, C+C 1131 ± 265W) or max peak power (highest maximal power of 4s sprint) ($p = 0.317$, Peta2 = 0.100, PLA 1226 ± 251W, CAF 1262 ± 232W, CHO 1214 ± 250, C+C 1232 ± 275W). There was a trend for RPE to be higher during C+C compared with CAF ($p = 0.051$, Peta2 = 0.215, PLA 18 ± 1, CAF 17 ± 2, CHO 17 ± 2, C+C 18 ± 2). There was a large variation between conditions for percentage performance decrement (mean peak power PLA 11 ± 6%, CAF 13 ± 7%, CHO 12 ± 9%, C+C 12 ± 8%; max peak power PLA 20 ± 5%, CAF 21 ± 7%, CHO 20 ± 9%, C+C 19 ± 8%).
Discussion
Neither CHO, CAF or C+C improved repeated sprint performance compared with PLA. Therefore, substrate availability may not be the limiting factor in performance, and we hypothesise that core temperature is the key fatiguing factor. Consequently, RPE perceptual change might elicit differing physiological states in line with the central governor theory. Therefore, further research could investigate aspects such as the effect of pre-cooling on intermittent sprint cycling in the heat with the objective of optimising substrate utilisation. Also, more investigation into the performance decrement individual responses would be appropriate within the applied setting.
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Contact
Rossc6@uni.coventry.ac.uk
Twitter @CoachChrisRoss

THE EFFECTS OF CAFFEINE, TAURINE OR CAFFEINE-TAURINE CO-INGESTION ON REPEAT-SPRINT CYCLING PERFORMANCE AND PHYSIOLOGICAL RESPONSES

WALDRON, M., JEFFRIES, O., PATTERSON, S.
ST MARY'S UNIVERSITY, UK; UNIVERSITY OF NEW ENGLAND, AUS

Introduction
This study investigated the effects of caffeine (C), taurine (T), caffeine and taurine co-ingestion (C+T) or placebo (P) on repeated Wingate cycling performance and associated physiological responses.
Methods
Seven male team sports players participated in a randomised, single-blind, cross-over study, where they completed three Wingate tests, each separated by 2-min, an hour after ingesting: C (5 mg/kg BM), T (50 mg/kg BM), C+T (5 mg/kg BM + 50 mg/kg BM) or P (5 mg/kg BM) in a gelatine capsule. Performance was measured on an ergometer, whilst blood lactate, perceived exertion, heart rate (HR), mean arterial pressure (MAP) and rate pressure product (RPP) were measured at rest (pre-supplement), baseline (1-h post-supplement) and during and after exercise.
Results
Magnitude-based inferences revealed that all of the supplements increased (small to moderate, likely to very likely) mean peak power (MPP), peak power (PP) and mean power (MP) compared to P, with greater MPP, PP and MP in T compared to C (small, possible). Intra-sprint fatigue index (%FIIntra) was greater in T compared to P and C (moderate, likely), whilst inter-sprint fatigue index (%FIInter) was lower in T compared to C (small, possible). C and C+T increased HR, MAP and RPP compared to P and T at baseline (moderate to very large, likely to most likely); however, these only remained higher in C compared to all conditions in the final sprint. T elicited greater improvements in performance compared to P, C or C+T, whilst reducing the typical chronotropic and pressor effects of C.

LOW, MEDIUM OR HIGH DOSE TYROSINE SUPPLEMENTATION DOES NOT INFLUENCE PROLONGED CYCLING PERFORMANCE IN THE HEAT.

TUMILTY, L., GREGORY, N., BECKMANN, M., THATCHER, R.
ABERYSTWYTH UNIVERSITY

Introduction
Fatigue during prolonged exercise in the heat may be associated with reduced brain catecholamine function. To date, one study has reported an improvement in exercise capacity in the heat following acute, oral administration of 150 mg/kg body mass tyrosine, a nutritional catecholamine precursor. Other studies have reported no effect using this dose, suggesting it may be insufficient to consistently influence brain catecholamine function. We systematically examined the effect of different tyrosine doses, hypothesising that a low dose would not influence, but a medium or high dose would enhance, cycling performance in the heat.
Methods
Eight healthy males [mean (± SD) age, 23 ± 4 years; stature, 181 ± 7 cm; body mass, 76.1 ± 5.9 kg; peak oxygen uptake (VO2peak), 4.1 ± 0.5 l/min], unacclimated to exercise in the heat, volunteered for the study. They performed a VO2peak test, a familiarisation trial 48 h later, then one week later, four experimental trials in 30°C and 60% relative humidity in a randomised, double-blind fashion, separated by 7 d. Participants consumed zero (PLA), 150 (LOW), 300 (MED) or 400 (HIGH) mg/kg body mass tyrosine, mixed in 2 x 300 ml tap water and sugar-free favoured squash, separated by 1 h. In LOW the total dose was delivered in the first 300 ml drink and in MED and HIGH the tyrosine was distributed equally between the two drinks to aid blinding. Participants cycled on an electrically braked ergometer for 60 min

at a constant intensity (129 ± 17 W) then completed a simulated time trial requiring the completion of an individual work target (326 ± 37 kJ).
Results
The ratio of plasma tyrosine: sigma(free-tryptophan, leucine, isoleucine, valine, phenylalanine, methionine), a key determinant of tyrosine influx into the brain, was similar across trials at baseline ($p = 0.657$) and markedly increased with tyrosine ingestion ($p < 0.01$). The peak increase was similar in MED (7.7-fold) and HIGH (8.2-fold), and higher than LOW (5.3-fold; $p < 0.05$). Exercise time (34.2 ± 2.5 min in PLA, 35.4 ± 5.9 min in LOW, 35.3 ± 5.2 min in MED and 36.5 ± 5.9 min in HIGH; $p = 0.588$) and cycling power output ($p = 0.653$) were not influenced by tyrosine ingestion. During exercise, there were no differences across trials in core and mean weighted skin temperature, heart rate, rating of perceived exertion and thermal sensation ($p > 0.05$).
Discussion
In our study, increasing circulating tyrosine availability, favouring influx into the brain, did not influence prolonged exercise performance in the heat, irrespective of dose. This probably reflects inherent rate-limiting mechanisms controlling brain catecholamine synthesis, particularly at higher tyrosine doses, or insufficient stress associated with prolonged exercise in the heat.
Contact
llt07@aber.ac.uk

LOADING THE CHALLENGE: TYROSINE INTAKE AND CARDIOVASCULAR RESPONSES TO COMPETITION

HASE, A., GORRIE-STONE, T., FREEMAN, P.
UNIVERSITY OF ESSEX

Introduction
The ingestion of tyrosine, a catecholamine precursor, has been shown to prevent performance decrements induced by demanding situations (Hase, Jung & aan het Rot, 2015). However, it is important to identify whether the effects of tyrosine are universal across different tasks, and through what mechanisms they occur. One potential mechanism is provided by the biopsychosocial model of challenge and threat (Blascovich & Mendes, 2000), which specifies that adrenal medullary catecholamine release plays a central role in the occurrence of challenge states, which have been linked to higher performance under pressure than threat states (Blascovich, Seery, Mugridge, Norris, & Weisbuch, 2004). The purpose of this study was thus to examine the impact of tyrosine loading on challenge and threat states, as well as on cognitive and motor performance.
Methods
A double-blind randomised crossover design with 42 participants (26 males; Mean age = 23.0 years, SD = 5.4) was used. Participants ingested a supplement (150mg/kg body weight of tyrosine or placebo) 55 minutes before performing the N-Back task and a bean-bag throwing task. Cognitive self-reports and cardiovascular data were obtained prior to each task to provide indicators of challenge and threat states.
Results
Generalised Estimating Equations analyses found that tyrosine was associated with significantly better performance than placebo on the bean-bag throwing task [B = -2.04, p = 0.01, CI(B): -3.60, -0.47], but not on the N-Back task [B = -0.52, p = 0.47, CI(B): -1.93, 0.89]. No significant differences were found on cognitive and cardiovascular indicators of challenge and threat states.
Discussion
The results indicate that tyrosine loading may improve motor performance, but that these effects do not operate via challenge and threat states. These findings encourage the use of tyrosine in research and applied settings as it presents a promising dietary intervention for improving motor performance under pressure.
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Contact
ahase@essex.ac.uk

THE EFFECT OF O CREATINE SUPPLEMENTATION COMBINED WITH A SHORT TERM WHOLE BODY VIBRATION TRAINING ON MOBILITY, BALANCE, AND STRENGTH IN OLD FEMALES

KAVIANI, M., GOUDARZIAN, M., RAHIMI, M., ABBASI, A.
ACADIA UNIVERSITY

Introduction
Creatine supplementation and whole body vibration training have been shown to be positively associated with greater physical fitness and performance compared with in elderly (Lau et al., 2011; Stec et al., 2010). Therefore, the purpose of this study was to investigate The effect of o creatine supplementation combined with a short term whole body vibration training on mobility, balance, and strength in old females.
Methods
In a double-blinded placebo controlled design, Thirty two healthy old women (aged 60 years and over) were randomly assigned into three conditions: (1) whole body vibration (WBV) training with creatine (WBV+Cr); (2) WBV training with placebo (WBV+P); (3) control. The WBV condition involved exercises for 10 days. Participants consumed 20g creatine daily, then followed with only 5g creatine in the subsequent days. Strength, mobility, and balance were measured by using mobility performance 30-meter walking and tandem gait tests were applied. Static and dynamic balance measured by Flamingo and Timed-Up and Go (TUG) tests. Muscle isometric and isotonic strength assessed by using dynamometer and leg extension tests.
Results
The changes differences in leg isometric strength (7.3 vs 0.6) and 30-meters walking performance (-2.97s vs -0.2 s) were significantly improved just in WBV+Cr group compare to control group.
Conclusion

It seems that short term WBV exercise combined with creatine supplementation might be more beneficial as a greater improvements were observed in leg isometric and isotonic strengths, dynamic balance, and 30-meters walking performance compared with WBC condition. Possibly, neural adaptations are the most relevant mechanism of strength improvement not only in strength training but also in vibration training, and it is suggested that vibration training induces biological adaptation such as neural potentiation, which is comparable to that of resistance and explosive strength training (Roelants et al., 2004).

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Contact
mojtaba.kaviani@acadiau.ca

THE EFFECTS OF CREATINE SUPPLEMENTATION ON EXPLOSIVE PERFORMANCE AND OPTIMAL INDIVIDUAL POSTACTIVATION POTENTIATION TIME OF UPPER BODY IN KAYAK ATHLETES

WANG, C.C., YANG, M.T., LIN, S.C., LEE, M.M., CHAN, K.H.
NAITONAL TAIPEI UNIVERSITY OF BUSINESS

Introduction
The efficacy of creatine (Cr) supplementation in enhancing explosive performance and skeletal muscle energy metabolism are well established. Postactivation potentiation (PAP) is a phenomenon that can acutely increase muscle power, but it is an individualized process that is influenced by muscle fatigue. No study has investigated the effects of PAP on upper body with Cr supplementation. Therefore, the aim of this study was to examine the effects of Cr supplementation on explosive performance and optimal individual PAP time of upper body in kayak athletes.
Methods
Seventeen kayak athletes performed tests of prone row for one repetition maximum (1RM) strength and complex training bouts for determining the optimal individual timing of PAP, distance of overhead medicine ball throw before and after the supplementation. Subjects were assigned to a creatine (Cr gr.) or placebo group (Pla gr.) and then consumed 20 g of Cr or carboxymethyl cellulose per day for six days.
Results
After supplementation, the 1RM strength in Cr gr. significantly increased from 85.63 ± 8.63 kg to 88.13 ± 8.35 kg ($p < 0.05$). The optimal individual PAP time in Cr gr. was significantly earlier than the pre-supplementation (9.75 ± 2.31 min vs. 8.12 ± 3.19min) ($p < 0.05$). However, there were no significant differences in 1RM strength and the optimal individual PAP time in Pla gr. and between the two groups ($p > 0.05$). Moreover, there was no significant change in distance of overhead throw for both groups ($p > 0.05$).
Discussion
This study indicated that the 1RM strength of prone row increased after Cr supplementation. One of the reasons may that Cr supplementation increased the rate of ATP synthesis to enhance the ability of a very power-demanding exercise such as 1RM (Stout et al. 2008). However, our study did not show any significant improvement in explosive performance. The reason may be due to that peak PAP was immediately increased by conditioning contraction, but instantly began to decrease with a rapid decline during the recovery period (Requena et al., 2008). Our finding supports that the optimal individual PAP time was significantly earlier after Cr supplementation. The outcome of this study was consistent with our previous study (Wang et al., 2016).

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Contact
sunnywango@gmail.com

Invited symposia

IS-EX01 CSSS-ECSS EXCHANGE SYMPOSIUM: EXERCISE PERFORMANCE AND HEALTH PROMOTION

DEVELOPMENT AND VALIDATION OF BODY FAT PREDICTION EQUATION IN 20–69 ADULTS

ZHAO, J., HUANG, C., HONG, P., HE, Z., WANG, M., TIAN, H., LI, R., ZHOU, J., XU, C., TIAN, Y.
CHINA INSTITUTE OF SPORT SCIENCE

Introduction
Skinfold thickness is commonly measured in clinical and field settings for the assessment of body fat percentage (BF%) because this method is low cost. A study was conducted to develop prediction equation for total body fat using surface anthropometric measures in adults aged 20–69 years old.
Methods
Data from 1225 healthy, yellow adults were used. The cohort was then divided into validation and cross-validation groups. Prediction equation was developed by using regression analyses in 1141 Chinese adults aged 20–69 years old. These adults were recruited from a larger randomly sampled population-based study. The independent variables included sex, age, height, mass, body mass index, chest girth, waist girth, hip girth, and skinfold thickness at nine sites. The dependent variable was total body fat percentage and was measured using dual-energy X-ray absorptiometry (DXA). Multiple linear regression was used to determine the best prediction equation for fat percentage. A total of 84 additional samples were included to verify the validity of the equation. Tests for accuracy included R2 and Bland-Altman plots.
Results
Using multiple linear regression analyses, the best equation for predicting FM (R2 = 0.758) included sex, age, height, body weight, body mass index, chest girth, hip girth, subscapular skinfold, triceps skinfold, biceps skinfold, chest skinfold, axillary line section skinfold, ab-

dominal skinfold, front thigh skin fold, and medial calf skinfold as independent variables. After cross-validation, the new predication equation (PE) was found to be valid in 20, 40, and 60 years old men and women (P<0.05). Bland-Altman plots showed limited agreement between body fat percentage (BF%) calculated with the prediction equation (PE) and BF% measured with dual-energy X-ray absorptiometry (DXA) in adults aged 20–29, 40–49, and 60–69 years old.
Discussion
A prediction equation was developed, and this was able to predict total body fat of adults aged 20–69 years old using surface anthropometric measurements with high predictive accuracy.

INVESTIGATION THE HEALTH BEHAVIOR OF SCHOOL-AGED CHILDREN IN HARBIN, NORTHEAST CHINA

WANG, M., WANGFU, B.H., LI, P.H.
CHINA INSTITUTE OF SPORT SCIENCE (CISS)

Introduction
Nowadays, physical fitness status of Chinese children and adolescents is declining, while incidence of obesity and physical inactivity rising sharply, which due to their unhealthy lifestyle may largely relating to health behaviors. Many studies carried out on health behaviors and lifestyle of children and adolescents in developed countries, among which "Investigation of Health Behavior of School Children (referred as HBSC)" is the most well-known. The purpose of this thesis was to examine current status of physical activity and dietary problems among school-aged children in Harbin, for exploring general health behavior issues and seeking resolution strategy.
Methods
Standard questionnaire of HBSC was used to investigate physical activity and dietary behaviors of children and adolescents in Northeast China especially in Harbin compared with similar high latitude Nordic counties, Finland. 2438 children at the age of 11, 13 and 15 in Harbin were sampled in the approach of multi-stage stratified random sampling. Analyze reasons causing data difference and delve into related factors which affect health behaviors. Descriptive statistics, chi-square test, independent sample T-test and ANOVA test used to compare difference of indicators, significance was achieved when P<0.05.
Results
9.4% of school-age children in Harbin accumulated at least 60 minutes of moderate to vigorous intensity physical activity daily, worse still average level of MVPA was only 2.73 days. 28.0% incorporated 3 times Vigorous-intensity activities per week. Average level of physical activity in school were 3.15 hours per week, proportion of physically active frequency and time in MVPA off-school were 37.5% and 14.5%. Only 9.7% participated in sport club or organized Sport.
41.4% of children and adolescents had bad eating habits, Picky Eating, monophagia, drinking sugary beverages and eating sweets were the most common bad eating habits. 82.1% had at least one kind of food they prefer not to eat. 2.8% of school-age children skipped breakfast, Lower than the 3rd NHANES 6.1% (U=4.53, P<0.01). 33.0% of children had unreasonable dietary structure, proportion who didn't eat soy and dairy products up to 21.6%, consistent with general low intake of protein in China.
Discussion
Children and youth are far more physical inactive in China, MVPA and VPA level significantly lower than Finland (28.0% & 68%). Sunshine sports policy not implemented and low participation in off-school physical exercise were main reasons for physical inactivity epidemic. Nutritional deficiencies and overnutrition were coexisted, Lack of trace elements and poor nutrition were at varying degrees in rural children, while overnutrition and high-calorie diet was severely in urban children.
Combined interactions of physical inactivity, high-calorie diet and irrational diet structure, which resulted in school-age children's health condition declining and obesity rising. Health behavior education, physical activity intervention and model healthy eating are urgent to implement in Harbin, China.

USING EXERCISE AND ALTERNATE STRATEGIES TO OPTIMISE CARDIOVASCULAR HEALTH

CABLE, N.T.
UNIVERSITY OF BIRMINGHAM

The endothelium is a monolayer of cells that forms the inner lining of blood vessels. It is now known that this layer of cells, in response to various stimuli, release a number of vasoactive substances that can markedly impact the functionality and structure of blood vessels. For example, exercise training in response to changes in the pattern of blood flow, is associated with enhanced release of nitric oxide (NO). This increased release of NO has the combined effect of improving the dilation of the vessel and also promoting an advantageous structural change, with a wider lumen and thinner wall. These changes confer a health benefit for the individual that is not only local to the stimulus, but also can bring about positive systemic changes in vascular beds that are remote to the stimulus applied. There is also strong evidence to suggest that these exercise-induced changes can be provoked under resting conditions, when individuals are subjected to periods of heating and ischaemia. This presentation will therefore review the types of exercise by can be used to bring about these positive changes, the mechanisms responsible for these adaptations, and also the impact that non-exercise interventions may have for vascular health, and the role that such interventions may play in protecting the health of populations where exercise is not well-tolerated.

Invited symposia

IS-BN07 BIG DATA IN SPORTS

BIG DATA IN SPORTS: THE DEVELOPER PERSPECTIVE

MCCORMICK-SMITH, A.
SAP SE

With the advent of large data sets in sports from different sources in professional sports clubs new challenges for data processing are to be met. First, computerized representations of each important field of activity have to be developed, and second, these fields have to be integrated with a common interface allowing cross-references.

Mandatory parts of a club information base are associated with training and competition. Training planning, documentation and follow-up processing must be realized in an easy-to-use manner. A special challenge is to make the large amounts of video, position, and action data suitable for analytical needs of the staff. Medical reports, treatments of physiotherapy as well as tracks and profiles of fitness testing are of growing importance in this setting. A rather new area of big data activities is to provide a learning environment for players for tactical instructions using specially designed media technology.
Data integration is solved by a cloud concept. The aim is to provide a team management solution that allows gaining a holistic view of each player and derive practical measures based on an optimal information base. The big data approach comprehends also support for player scouting, a decisive task for the management of professional football teams.
It is a well founded assumption that big data in sports will promote the management of professional football teams to new more data driven and scientifically founded level in near future.

BIG DATA IN SPORTS: THE ANALYTICS PERSPECTIVE

LUCEY, P.
STATS

The advent of big data in sports has created a new era in sports analytics. There are new ways to forecast game behaviour by detecting hidden rules of the game with big data methods. Moreover, we are able to analyse constructs that were only to be assessed by qualitative and subjective inspection of video data before. Nevertheless, even big data in sports rely on the quality of basic information. Recently, new methods were introduced to improve the use of, inevitably, noisy data.
Prediction of actions based on spatiotemporal data requires action rules to be generated for specific situations. There are several examples, e.g. from basketball, tennis, and football, proving that, given spatiotemporal data, forecasting shots, events, and plays is possible within reasonable constraints. For example, we analysed the spatiotemporal patterns of the ten-second window of play before a shot for nearly 10,000 shots and found characteristic determinants for successful attacks in football.
Usually, spatiotemporal data is too grass-rooted to directly reveal the information users in sports practice are looking for. For this reason, it is mandatory to extend the analysis to entities on a higher level of abstraction. It will be demonstrated how team formations, playing style and team strategies can be derived from spatiotemporal data.
Big data in sports has provided new analytical perspectives, possibly having a large impact on practice as well as on our theoretical understanding of football.

BIG DATA IN SPORTS: THE SPORTS PERSPECTIVE

VOLOSSOVITCH, A.
FACULDADE DE MOTRICIDADE HUMANA UNIVERSIDADE DE LISBOA

Over the past decades the technological advances and the need for reliable information about key aspects of performance led to the development of different strategies for observing and evaluating the performance in sports games. Contemporary match analysis systems using networks of synchronised cameras and tracking devices tend to capture technical, tactical, physical and physiological aspects of performance at an individual and collective level, and represent a strong argument for the organization and evaluation of the training process. Notational data (based on game-related statistics and frequencies of actions) quantitatively evaluates players' and teams' performances in different game contexts and assesses the effectiveness of game strategies; time-motion analysis provides the knowledge about competitive activity profiles, physical and physiological demands of the game; the positional data from players' tracking in match-play ensure the better understanding of factors that influence the interpersonal and teams' coordination during the game. However, the huge amounts of data provided by numerous data sources in sports games create the problem regarding the "Big data" governance and interpretation. Overcoming this problem requires changing the focus from data-driven to data-informed approach, which ensure the efficient use of available data by coaches and performance analysts. A more substantial research effort is needed to develop prospective mathematical models, which convert a vast volume of data into a reduced set of useful variables for decision-making in sports.

Oral presentations

OP-BN11 Adaptations of the muscle-tendon system

OPERATING LENGTH AND ACTIVATION OF M. VASTUS LATERALIS FASCICLES DURING WALKING AND RUNNING

BOHM, S., MARZILGER, R., ARAMPATZIS, A.
HUMBOLDT-UNIVERSITÄT ZU BERLIN

Introduction
According to the force-length-velocity relationships the force potential of a muscle is determined by the operating length and velocity of its fibers. Roberts et al. (1997) showed that the muscle fibers of turkeys during the stance phase of locomotion work almost isometrically (changes of 2-6% of resting length), thus, featuring a high force potential. In contrast, musculoskeletal models of human walking and running predict a stretch-shorting cycle of m. vastus lateralis (VL) with substantial fascicle length changes (20-25% of resting length; Arnold et al., 2013). However, the fascicle behavior of human proximal muscles has not been experimentally determined yet. The study purpose was to investigate the operating length and activation of VL during locomotion. We hypothesized that adjusted muscle activation controls the intrinsic muscle mechanics (i.e. force-length-velocity relationships) to facilitate force generation.
Methods
Kinematic analysis, ultrasound and electromyography were combined to assess the length of the muscle-tendon unit and fascicles as well as the activation of VL during walking (1.5 m/s) and running (3.0 m/s), respectively (n=30). The individual force-fascicle length relationship of VL was determined on the basis of maximal voluntary knee extensions by means of dynamometry and ultrasound, while the force applied to the patellar tendon was calculated using individual level arms obtained from magnetic resonance images. Accordingly, the maximum force and optimal fascicle length were experimentally determined and the force potential during locomotion calculated as a function of fascicle length.

Results
During the stance phase of walking and running VL fascicles showed smaller length changes (7.8±4.8% and 9.1±8.4% of optimal length) compared to the muscle-tendon unit (19.7±5.3% and 34.8±6.1%). The averaged fascicle length was greater for running (100±11 mm) in comparison to walking (89±11 mm), however, in both gaits fascicles operated close to their optimum (94±11 mm), which resulted in a force-length potential of 0.95±0.06 and 0.93±0.01, respectively. Relevant fascicle length changes occurred only during the inactive muscle state.
Discussion
The results provide first-time evidence that (a) the fascicles of human VL operate almost isometrically close to their optimal length during the stance phase of walking and running and that (b) this favourable condition for force generation was likely the result of adjusted activation. In opposite to the model predictions the findings further indicate an important contribution of series elastic elements to the fascicle length behavior of proximal lower limb muscles during daily life activities.
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Contact
sebastian.bohm@hu-berlin.de

COMPARISON OF TWO MINUTES STATIC STRETCHING WITH CONSTANT TORQUE OR CONSTANT ANGLE – EFFECTS ON THE MUSCLE-TENDON-UNIT

TILP, M.
UNIVERSITY GRAZ

Introduction
During static stretching the modalities like intensity or duration affect the result on the muscle-tendon unit. It was reported that stretching when performed with constant torque (CTS) instead of constant angle (CAS) leads to greater increases in range of motion (RoM) (Cabido et al. 2014). Whether or not these changes are related to differences in the effects on the muscle or tendon structure is not known. Therefore, the aim of the study was to compare the results of CTS and CAS stretching on function and structure of the muscle-tendon unit.
Methods
Seventeen young healthy volunteers (8 females: 23.3 ± 2.5 years, 167.9 ± 6.3 cm, 58.8 ± 3.9 kg and 9 males: 24.9 ± 4.2 years, 182.6 ± 6.0 cm, 77.3 ± 6.6 kg) were tested on two separate days before and following either a CTS or CAS exercise (4 x 30 s) on the calf muscles. We assessed maximum dorsiflexion RoM, passive resistive torque (PRT), and maximum voluntary contraction (MVC) of the plantar flexors with a dynamometer. Stiffness of the gastrocnemius medialis muscle and the Achilles tendon was assessed with ultrasonography combined with dynamometry. Data was tested for normal distribution (Shapiro Wilk test) and depending on the outcome a two way repeated measures ANOVA or Friedman test with related post hoc comparisons was used to detect differences between the stretching methods. Alpha level was set to 0.05 to indicate significance.
Results
The RoM increased and PRT decreased following both modalities but CTS led to higher changes compared to CAS. Furthermore, muscle stiffness and muscle-tendon (joint) stiffness decreased while MVC and tendon stiffness did not change following the stretching exercises. Changes in muscle and tendon structure were not significantly different between CTS and CAS.
Discussion
We could confirm previous results that showed that static stretching for 2 minutes leads to more compliant muscle structure but does not alter tendon properties (Konrad et al. 2016). Furthermore, CTS led to greater increases in RoM and greater decreases in PRT (Cabido et al. 2014). However, we could not detect the cause of these differences in the muscle or tendon structure. It could be speculated that differences due to the tested stretching modalities are related to dissimilar reaction of the nervous system, i.e. perception of stretch or stretch tolerance. According to our findings we suggest that CTS may be more appropriate in sports practice when higher gains in RoM are favoured.
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Contact
markus.tilp@uni-graz.at

STRETCHING OF ACTIVE MUSCLE EVOKES GREATER ACUTE INCREASES IN PLANTARFLEXOR RANGE OF MOTION THAN STATIC STRETCHING

KAY, A.D.1, KHAN, S.1, BAROSS, A.W.1, BLAZEVICH, A.J.2
1: UON (NORTHAMPTON, UNITED KINGDOM), 2: ECU (PERTH, AUSTRALIA)

Introduction
Increases in joint range of motion (ROM) in athletic and clinical populations are normally achieved through static stretching. However, substantially greater increases in ROM were recently reported after a 6-week exercise programme when stretch was imposed on active muscle (Kay et al., 2016), although acute effects remain unknown. Therefore, the present study compared the effects of acute and repeated bouts of active muscle stretching and static stretching of the plantarflexors.
Methods
Using a randomised, crossover design, 18 recreationally active subjects completed four trials under two experimental conditions (static stretch [SS1, SS2]; active muscle stretch [AMS1, AMS2]), with each trial separated by 48-72 h. SS trials comprised 5 sets of 30-s static stretches whilst AMS trials comprised 5 sets of 10 repetitions of 3-s stretches imposed on maximally contracted muscle (total loading in each trial = 150 s). Before and after each set, dorsiflexion ROM and passive plantarflexor moment were recorded on an isokinetic dynamometer, electromyograhic (EMG) activity of the soleus and ultrasound imaging of Achilles tendon and medial gastrocnemius fascicle elongation were simultaneously recorded.
Results

A significantly (P<0.05) greater increase in ROM was observed in AMS (5.9°-7.7°) than SS (2.2-3.0°) trials, with ROM significantly greater after AMS2 than all other trials (+3.3-5.8°). Furthermore, a significant increase in ROM was already detected after the first set in AMS trials (2.2-3.1°), and this was similar to the magnitude of change after 5 sets of stretches in SS trials. Similar decreases in the passive moment slope occurred after SS (7.3%-11.7%) and AMS (10.1%-15.3%) trials, however significant increases in peak passive moment (30.7-34.7%) and elastic energy storage (54.3-68.2%) occurred only after AMS. A significant reduction in maximal isometric (i.e. active) moment occurred only after SS1 (6.5%).

Discussion

These data have important practical implications as similar increases in ROM were achieved after a single set of AMS compared with multiple static stretches (i.e. current practice), without a reduction in active muscle force. Furthermore, when time under loading was identical, AMS resulted in a more than twofold greater increase in ROM, indicating that it is more effective and efficient than current stretching practices. The significantly greater ROM after the second AMS trial indicates a repeated bout effect that may explain the previously reported greater long-term adaptations in ROM.

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Contact

tony.kay@northampton.ac.uk

SHORT-TERM INCIDENCES OF ISOMETRIC CONTRACTION ASSOCIATED TO VIBRATION ON MUSCLE ELASTIC COMPONENTS

GERMAIN, PH., GHALAS, S., ATTIOGBÉ, E., GERMAIN, A., PICHON, CH., BOSQUET, L., DRISS, T., LARUE, J.

** MOVE LABORATORY (EA 6314) POITIERS UNIVERSITY, ** CBM (UPR 4103) CNRS ORLEANS AND ORLEANS UNIVERSITY, *** LABORATORY CERSM (EA 2931) PARIS NANTERRE UNIVERSITY, **** CIAMS LABORATORY (EA 4532)*

Introduction

During isometric muscle contraction, various cytoskeleton proteins are involved in lateral and longitudinal force transfer (Hugues et al., 2015). An over-imposed vibration can induce rapid stretch-shortening cycles of low magnitude. A first consequence is an elevation of the muscle level of activation (Lienhard et al., 2015). A second one depends on the eccentric mechanical stress induced. A response of no-motor proteins involved in actomyosin machinery (Herzog et al., 2015, Atherton et al., 2015) is possible with force or stiffness enhancement. The aim of this study is to investigate short-term muscle stiffness adaptations after isometric + vibration (IV) contractions.

Methods

The subjects maintained a light flexed standing up position, with or without Whole Body Vibration (WBV) (Rizmann et al., 2013), at 50Hz, with 2 mm of movement of the vertical plate, 3 times 3 minutes, separated by 2 minutes of rest period. Before and after the exercise a 'Quick Release' test was performed to determine the musculo-tendinous stiffness of the plantar ankle flexor muscles, in reference to the methodology of Lambertz et al. (2008).

Results

Musclo-tendinous stiffness, before and after exercise, raised up respectively of 8,7% (P < .05) and 1,6 % (NS) for isometric-strict and IV groups and stiffness reported to the % of MVC described a linear progression with the R2 from 0.9 to 0.98.

Discussion

The higher muscle activation induced by the WBV was able to be more fatiguing for muscle and a higher proportion of slow fibres (ST) involved during post-test was expected. The ST being stiffer our results don't verify this hypothesis. Because vibrations induced a muscle stretch (3.65 % of his length) and a rapid stretch time (10ms) which together could induce a mechanism of stretch and release (reference to Hill, 1952) we hypothesized that an exercise with vibration could massively involve the muscles elastic component and the lower progression of stiffness for IV group could be explained by the effects on Titin and Talin-Vinculin complex of 4500 repetitive stretch.

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CONDITIONING HOPS INCREASE TRICEPS SURAE MUSCLE FORCE AND ACHILLES TENDON STRAIN ENERGY IN THE STRETCH-SHORTENING CYCLE

KÜMMEL, J., CRONIN, N.J., KRAMER, A., AVELA, J., GRUBER, M.

UNIVERSITY OF KONSTANZ

Introduction

It has been shown that a set of maximal reactive hops can induce post-activation potentiation in the triceps surae muscle and enhance drop jump (DJ) performance (Bergmann et al., 2013). The underlying mechanisms are not clear yet. However, the enhanced DJ performance is unlikely the result of neural changes, as no differences in muscle activity could be observed during the conditioned drop jumps. In the present study we hypothesized that hops can modulate the muscle-tendon interaction, facilitating higher energy transfer from the eccentric to the concentric part of the SSC.

Methods

Thirty-two subjects participated in two experiments. In both experiments, subjects performed three DJs after prior conditioning with 10 maximal hops, three unconditioned DJs served as control. Ground reaction forces, kinematics, and triceps surae electromyographic activity were recorded. Ultrasound imaging was used to determine fascicle lengths of the gastrocnemius and soleus muscles (experiment 1) and the length of the Achilles tendon (experiment 2) during the DJs.

Results

DJ height after the conditioning hops was significantly higher compared to control DJs (experiment 1: +12% and experiment 2: +19%). A significantly shorter gastrocnemius fascicle length at the beginning of the concentric phase during the DJs performed after the conditioning hops coincided with an increased force acting on the triceps surae muscle. The triceps surae muscle-tendon unit showed increased energy absorption during the eccentric phase of the DJs (~10 %), and increased energy release during the concentric phase (~10 %). The second experiment revealed a higher Achilles tendon strain (+5 mm) in DJs performed after the conditioning hops compared to control DJs. No significant differences in muscle activities were observed.
Discussion
The shorter fascicle length in gastrocnemius, the higher force acting on the triceps surae, and the larger Achilles tendon strain were associated with improved muscle-tendon unit energy transfer from the eccentric to the concentric phase during the DJ. Thus, conditioning hops improved SSC efficacy of the triceps surae muscle-tendon unit and contributed to potentiated DJ performance. The underlying mechanism is rather a modulation in intrinsic muscle properties than neuroplasticity as no changes in muscle activities could be observed. The results of the present study highlight the potential for hops as a conditioning activity to potentiate subsequent SSC performance.
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Contact
Jakob.kuemmel@uni-konstanz.de

EFFECTS OF WARM-UP ON HAMSTRING MUSCLES STIFFNESS: CYCLING VS. FOAM ROLLING

GUILHEM, G., MORALES-ARTACHO, A., LACOURPAILLE, L.
FRENCH INSTITUTE OF SPORT (INSEP)

Introduction
Warm-up routines have usually been performed to prepare the body for subsequent specific exercises (McGowan et al. 2015). Active (e.g. cycling) and/or passive (e.g. foam-rolling) warm-up tasks have been shown to acutely increase maximal range of motion (ROM) and to decrease musculo-articular stiffness. However, there is conflicting evidence on the effects of different warm-ups on muscle stiffness when exploring muscle stiffness in vivo. Elastographic methods have been recently used to appraise the stiffness of biological tissues, by measuring shear wave propagation velocity (Hug et al. 2015). This study investigated the effects of active and/or passive warm-up tasks on the hamstring muscles stiffness through elastography and passive torque measurements.
Methods
Fourteen males randomly completed four warm-up protocols comprising Control, Cycling, Foam-rolling or Cycling plus Foam-rolling (Mixed). The stiffness of the hamstring muscles was assessed through shear wave elastography, along with the passive torque-angle relationship and ROM before, 5-min, and 30-min after each experimental condition.
Results
At 5-min, Cycling and Mixed decreased shear modulus (-10.3 ± 5.9% and -7.7 ± 8.4%, respectively; $P \leq 0.0003$, $ES \geq 0.24$) and passive torque (-7.17 ± 8.6% and -6.2 ± 7.5%, respectively; $P \leq 0.051$, $ES \geq 0.28$), and increased ROM (+2.9 ± 2.9% and +3.2 ± 3.5%, respectively; $P \leq 0.001$, $ES \geq 0.30$). 30 min following Mixed, shear modulus and passive torque were still slightly decreased, while ROM increased ($P < 0.05$, $ES = 0.24$). Foam-rolling induced "small" immediate short-term decreases in shear modulus (-5.4 ± 5.7% at 5-min; $ES = 0.21$).
Discussion
The greater magnitude of shear modulus changes observed after cycling suggest the significance of temperature-mediated warm-up mechanisms on muscle stiffness and contractile properties (Marshall et al. 2015). These results suggest that the combined warm-up elicited no acute superior effects on muscle stiffness compared to cycling, providing evidence for the key role of active warm-up to reduce muscle stiffness. The time between warm-up and competition should be considered when optimising the effects on muscle stiffness.
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Contact
gael.guilhem@insep.fr

Oral presentations

OP-PM24 Testing in game sports

ARE GENERAL PHYSICAL TESTS SUITABLE TO PREDICT SPECIFIC TEAM SPORT PERFORMANCE?

WAGNER, H., SPERL, B., BACHERACH, D.W., VON DUVILLARD, S.P.
UNIVERSITY OF SALZBURG

Introduction
Team sports are characterized by a frequent change in intensities and different complex movements during the game, whereas performance has been tested mainly via standardized general tests. The aims of our study were to measure and compare general and specific performance in experienced team handball players and to discuss how these results are transferable to other team sports.
Methods
Seventy-two experienced male indoor field team handball players performed a game based performance test, an upper-body strength tests, a 30m sprint test, a counter movement jump test and an incremental treadmill running test. We measured peak oxygen uptake, utilizing portable metabolic system (Cosmed K4B2), blood lactate concentration (EKF, Biosen C), heart rate (Polar, Kempele, Finland), sprinting time, and offensive and defensive time actions (Inmotion LPM-system, Abatec, Austria), ball velocity and jump height during a jump shot (PeakMotus, Vicon Peak, UK), shoulder rotation torque (ISOMED, D&R Ferstl, Germany), as well as jump height in the counter movement jump (AMTI, Watertown, USA). To determine the prediction of the specific performance by the general test performance a linear regression were utilized. Additionally a principal component factor analysis was calculated to extract separate components.

Results
Principal component factor analysis revealed separate components for specific and general performance with a cumulative variance of 71%. Linear regression analyses revealed a low correlation between maximal oxygen uptake in the incremental treadmill running test and peak oxygen uptake in the game based performance test (r=0.33), 30m sprinting time and defense time in the game based performance test (r=0.35), jump height in the counter movement jump test and jump height in the jump shot (r=0.41) as well as isokinetic shoulder rotation torque and ball velocity in the jump shot (r=0.19).
Discussion
The results of the present study clearly indicate that general tests are not suitable to predict team handball specific performance. Based on previous studies in other team sports (soccer, basketball, American and Australian football, rugby, etc.) we suggest that game based performance tests including different specific movements and a frequent change of intensities are essential to determine specific team sport performance. Additional studies are warranted.

EXPLORING PASSING SKILLS OF SOCCER PLAYERS ACCORDING TO THEIR PLAYING POSITIONS

SAAL, C., LANWEHR, R., FIEDLER, H., MAYER, J.
UNIVERSITY LEIPZIG

Introduction
In soccer, skill tests that measure passing and ball control are essential parts in performance diagnostic. While the influence of age on these soccer skills are widely discussed, the influence of playing position is rarely addressed. The aim of this study is to explore the effect of playing position and age on soccer skills by using the Footbonaut®.
Methods
Elite soccer players (n = 154) were classified in three groups according to their age (U12 - U14, U15 - U17, U19 - Profi) and playing position (defender, midfielder, striker). They completed at least one session of a passing test (Saal et al., 2015) using the Footbonaut®. The Footbonaut test requires players to complete 32 passes as quick and accurate as possible. Soccer skills were quantified by means of execution time [ms| and accuracy [%].
Results
A first two-way ANOVA yielded a non-significant effect for the playing position, $F(2, 145) = 1.49$, $p = 0.22$, eta = 0.01 on execution time. The effect of age on execution time was significant, $F(2, 145) = 16.03$, $p < 0.001$, eta = 0.36, such that execution time decreased significantly with age. A second ANOVA yielded non-significant effects for playing position, age and the interaction between both on passing accuracy.
Discussion
First, playing position does not influence soccer skills and there is no interaction between age and playing position. Second, execution time decreased significantly with age. This result corresponds to those of other authors (Konzag, 1979; McDermott et al., 2015). The first result could be due to the fact, that the stimuli does not represent a specific pattern regarding to the playing position. Furthermore a distinction between central and wide players might lead to different results. In conclusion, the Footbonaut test may be used to measure unspecific soccer skills rather than skills relating to player position.
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Contact
Christian.Saal@uni-leipzig.de

RELATIONSHIP BETWEEN LINEAR RUNNING PERFORMANCE AND CHANGE OF DIRECTION PERFORMANCE OF MALE SOCCER PLAYERS

ÇINARLI, F.S., KAFKAS, A., KAFKAS, M.E.
INONU UNIVERSITY

Introduction
During a soccer game, players perform repeated bouts of low-level activity such as walking, jogging or cruising in conjunction with high-intensity actions such as sprinting, jumping and directional changes (Rouissi et al., 2016). The ability to sprint, accelerate and decelerate alongside change of direction is commonly known as agility. The purpose of this study was to analyze the relationship between linear performance and agility performance scores and to determine the most appropriate agility test for soccer players.
Methods
Sixteen male soccer players (age: 21.93±3.62 years, height: 175.06±3.06 cm, body mass: 69.51±7.40 kg, BMI: 22.67±2.16 kg/cm2, body fat: 7.52±2.64%) participated in linear sprint and COD tests. All participants completed a test battery involving linear sprinting (10, 20, 30m), COD sprinting (T-Test, 505, Pro-agility, Illinois), and vertical jumping test (countermovement jump without arm swing, countermovement jump with arm swing respectively).
Results
The 10, 20, and 30m sprint performance were positively correlated (r=.329, p=.272; r=.370, p=.214; r=.338, p=.259 respectively) with performance on T test. In addition, the 10, 20, and 30m sprint performance were positively correlated (r=.507, p=.077; r=.454, p=.119; r=.425, p=.147 respectively) with performance on the 505 test. Furthermore, the 10, 20, and 30m sprint performance were positively correlated (r=.329, p=.272; r=.370, p=.214; r=.338, p=.259 respectively) with performance on pro-agility test. Lastly, the 10, 20, and 30m sprint performance were positively correlated (r=.635, p=.020; r=.802, p=.001; r=.849, p=.000 respectively) with performance on the illinois agility test.
Discussion
Our findings were comparable with other studies that investigated the relationship between agility tests (change of direction speed tests) and vertical jump (CMJ) and straight sprint (10, 20, 30m) tests (Little and Williams, 2005; Peterson et al. 2006). They also reported a low correlation between T-test and acceleration (20-yard as split time of 40- yard). Therefore, it may be stated that the most appropriate agility test for soccer players is the T agility test.

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NO RELATIONSHIP BETWEEN MATCH MINUTES PLAYED AND YYIRT1 IMPROVEMENTS

MURATORE, M., ODDO, A., BELLISTRI, G.
NOVARA CALCIO S.P.A.

Introduction
The Yo-Yo intermittent recovery test level 1 (YYIRT1) is widely used in soccer (Bangsbo et al., 2008). Deprez et al. (2015) showed that YYIRT1 is a valid and reliable field test for young soccer players. Furthermore, the YYIRT1 performance changes during the season in young players in response to a training period (Fanchini et al., 2014). The workload imposed by match determine higher external work in players that play a great number of match than others. Nevertheless, no information is presented about the relation between the changes in YYIRT1 performance and the minutes played in official match in young soccer players. Thus, the aim of this study is to analyze the effect of minutes played on changes in YYIRT1 performance in young soccer players.
Methods
Fourteen elite U15 soccer players (age: 14.7+/-0.2 yrs, weight: 61.7+/-7.1 kg, height: 1.71+/-0.4 m; BMI: 17.5 kg•m-2) were recruited in this study. Subjects performed YYIRT1 in two different moments of the first part of the season (August-January). All players knew this test and they have been performed it during the previous season. The first assessment was performed during the preparatory period, after 5 weeks of training (PRE). The second one during competitive period, to 4 months from the first test (POST). All players have performed the same number and kind of training through the two evaluation moments; 13 matches and 64 training were performed. Only players that took part in 95% of training were included in this study. Data were expressed as mean ± SD. Differences between PRE and POST were determined using a paired t-test. Relationship between YYIRT1 delta POST-PRE (DELTA) and minutes played was evaluated using Pearson's product moment test.
Results
The YYIRT1 performance was significantly higher in POST vs PRE (1857+/-453 m vs 2152+/-573 m). However, no significant correlation was observed between minutes played in matches and DELTA.
Conclusion
As expected, in accordance with data reported by Fanchini et al. (2014), our study showed increase in performance of YYIRT1 (16%) after 18 weeks of training and matches. However, no relationship between minutes played in matches and improvement in YYIRT1 was found. Therefore these results seems to underlined that the YYIRT1 performance is not influenced by physical effort performed in the match and the improvement in the test performance was due to only training of which, no information was reported about its characteristics.
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Contact
muratoremarcello@yahoo.it

THE RELATIONSHIPS AMONG TWO REPEATED ACTIVITY TESTS AND AEROBIC FITNESS OF VOLLEYBALL PLAYERS

MECKEL, Y., MAY-ROM, M., EKSHTEIN, A., EISENSTEIN, T., NEMET, D., ELIAKIM, A.
ZINMAN COLLEGE FOR PHYSICAL EDUCATION AND SPORT SCIENCES

Introduction
In order to examine the ability of athletes to performed intense intermittent activity, repeated activity tests have usually employed rhythmic exercise such as running or cycling (McGawley and Bishop, 2006). However, in sports such as volleyball jumping serves as the leading type of action during the game (Bergeles et al., 2009). It was also suggested that a higher level of aerobic fitness is required for improved performance during intense intermittent activity (Meckel et al., 2009). The aim of the present study, therefore, was to determine performance indices of repeated sprint test (RST), and to examine their relationships with performance indices of repeated jump test (RJT), and with aerobic fitness (VO2 max) among trained volleyball players.
Methods
Sixteen male volleyball players performed RST (6 X 30m sprints), RJT (6 sets of 6 consecutive jumps), and an aerobic power test (20m Shuttle Run Test). Performance indices for the RST and the RJT were: 1. ideal 30-m run time (IS), total run time (TS) of the 6 sprints, and performance decrement (PD) during the test; and 2. ideal jump height (IJ), total jump height (TJ) of all the jumps, and performance decrement (PD) during the test, respectively.
Results
No significant correlations were found between performance indices of the RST and RJT. Significant correlations were found between PD, IS, and TS in the RST protocol and predicted VO2 max (r= -0.60, -0.75, -0.77, respectively). No significant correlations were found between performance indices of the RJT (IJ, TJ and PD) and predicted VO2 max.
Discussion
The findings suggest that a selection of repeated activity test protocols should acknowledge the specific technique used in the sport, and that a distinct RJT, rather than the classic RST, is more appropriate for assessing the anaerobic capabilities of volleyball players. The findings also suggest that aerobic fitness plays only a minor role in performance maintenance throughout characteristic repeated jumping activity of a volleyball game.
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CONSTRUCT VALIDITY AND TEST-RETEST RELIABILITY OF THE FORCE-VELOCITY PROFILE IN A GOLF SPECIFIC ROTATION MOVEMENT

PARKER, J.

HALMSTAD UNIVERSITY

Introduction
Assessing the isoinertial force-velocity (F-V) and power relationships has previously been found valuable to assist the understanding of the underlying mechanisms responsible for maximal power output. Multiple studies have investigated the F-V profile in the lower body, however, few studies have investigated F-V profiling in rotational movements, in particular, the golf swing. There is a need for isoinertial strength assessment protocols which can relate to final swing performance. The specific objective of the study was to investigate if measurements of force, velocity, and power using five different loads in a golf specific rotational movement are valid and reliable.
Methods
12 elite golfers (handicap -1.5±1.2) 8 men and 4 women performed a golf relevant rotational movement using five different loads (2, 6, 10, 14, 18 kg) in a motorised cable machine (1080 Motion AB, Sweden), measuring exercise peak force (PF), peak velocity (PV), and peak power (PP). In addition, normal-swing driver clubhead speed (CHSnor), and maximum clubhead speed (CHSmax) was measured using radar (Trackman, Denmark). The best of three trials for CHSnor, CHSmax, and the golf rotation was used for further analysis. Test-retest occasions were separated by 7-14 days. Statistical analysis: Change in mean (CIM) individual inter-session coefficient of variation (CV) and intraclass correlation coefficient (ICC) was used to analyse test-retest reliability, a spearman's correlation between the rotation output variables and the CHS was used to assess construct validity.For reliability an ICC of >0.70 was considered acceptable and results for correlation were considered excellent (≥0.90), good (0.75–0.89), moderate (0.50–0.74), poor (<0.50).was considered to be acceptable.
Results
PF, PV, and PP for all of the five loads, apart from PP with 2 kg (CIM=12.2%, CV=14.1%, &ICC= 0.29) and PP with 18kg (CIM=8.6%, CV=19.1%, & ICC= 0.93), showed good reliability (CIM= 0.05-3.6%, CV=1.4-8.5%, & ICC= 0.84-0.97). PF (r=0.780-0.89 & 0.75-0.88), PV (r=0.76-0.86 & 0.78-0.85), and PP (r=0.75-0.84 & 0.76-0.85) for all loads had statistically significant strong correlations with both CHSnor and CHSmax respectively, apart from PF at 2kg (r=0.33). The average day to day variation among all loads for PF, PV and PP were 17.9 ±13.7 N, 0.30 ± 0.23 m/s, and 135.9 ± 128.1 W respectively. Greatest PP was achieved with the 14 kg load, although PP at 6, 10, and 14kg only differed by 90 W (8%) between these loads.
Discussion
Isoinertial force-velocity-power profiling in high-level golfers can be assessed although a familiarisation session. The strongest correlation among the rotational tests and CHS was between PF at 10 kg and CHSnor (r=0.89) in general the PF, PV, and PP variables had a strong relationship with both CHSnor and CHSmax. Such profiling may provide valuable information insight into the neuromuscular capabilities of high-level golfers and may be used to monitor specific training adaptions.

Oral presentations

OP-PM25 Performance in jumping and sprinting

RELATIONSHIP BETWEEN ONE-REPETITION MAXIMUM OF PLANTAR FLEXORS WITH JUMPING AND SPRINTING PERFORMANCES

MICKEL, C., HARTMANN, R., MÖCK, S., WIRTH, K.

INSTITUTE FOR SPORTS SCIENCE

Introduction
Research on the importance of maximal force production on jumping and sprinting performances has focused on knee and hip extensors (Chelly et al. 2009; Wisløff et al. 2004). However, plantar flexors also contribute in these movements. Therefore, the aim of our study was to determine the relationships between one-repetition maximum (1RM) of plantar flexors with different jumping performances and sprinting performance.
Methods
56 physical education students participated in the study (40m, 16f; 27±3,0y; 176,9±8,1cm; 74,2±10,3kg). The measurements took place on four occasions with an interspace of one week. In the first test session, sprinting times were determined and the familiarization for the jumping tests (squat (SJ), countermovement (CMJ), and drop jumps (DJ) with different fall heights) was performed. In the second test session, jumping tests and the familiarization for the dynamical maximal strength test were performed. In the third and fourth session 1RM of the standing calf raise was determined (test-retest: r=0.987).
For the statistical analysis, the best values were used. Testing for normal distribution using Kolmogorov-Smirnov test revealed no significant differences. Therefore, the requirements for Pearson's product-moment correlation were fulfilled. The level of significance for all the tests was set a priori to p≤0.05.
Results
We found strong correlations for absolute and relative (1RM/bodyweight) 1RM in standing calf raise with SJ (abs.: r=0.659, p<0.01; rel.: r=0.575, p<0.01) and CMJ (abs.: r=0.708, p<0.01; rel.: r=0.565, p<0.01), weak to moderate correlations for performance parameter (jumping height (mm) / ground contact time (ms) x 100) (abs.: 16 r=0.362, 24 r=0.379, 32 r=0.526, 40 r=0.514, 48 r=0.457, p<0.01; rel.: 16 r=0.436, 24 r=0.472, 32 r=0.573, 40 r=0.535, 48 r=0.521, p<0.01) and jumping height in DJs from different heights (abs.: 16 r=0.329, 24 r=0.292, 32 r=0.447, 40 r=0.498, 48 r=0.451, p<0.01; rel.: 16 r=0.368, 24 r=0.375, 32 r=0.484, 40 r=0.492, 48 r=0.456, p<0.01), and moderate to strong correlations with consecutive 5m intervals in 30m sprint (abs.: 0-5m r=-0.483, 5-10m r=-0.663, 10-15m r=-0.657, 15-20m r=-0.741, 20-25m r=-0.700, 25-30m r=-0.720, p<0.01; rel.: 0-5m r=-0.460, 5-10m r=-0.541, 10-15m r=-0.508, 15-20m r=-0.564, 20-25m r=-0.545, 25-30m r=-577, p<0.01).
Discussion
The correlations clearly show the importance of the maximal force production of plantar flexors on jumping and sprinting performances.
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Contact
C.Mickel@sport.uni-frankfurt.de

NEUROMUSCULAR EFFECTS TO SIX WEEKS OF LOADED COUNTERMOVEMENT JUMPING WITH TRADITIONAL AND DAILY UNDULATING PERIODIZATION

ULLRICH, B., PELZER, T., PFEIFFER, M.

OLYMPIC TRAINING AND TESTING CENTRE OF RHINELAND-PALATINATE/SAARLAND

Introduction
Loaded vertical jumps are routinely used to enhance athlete's power production in the lower extremity and to optimize jumping and sprinting performance (Cormie et al., 2007). Therefore, enhancing the effectiveness of loaded jumping programs is of practical relevance for conditioning experts. Periodization is a key feature to optimize conditioning periods, but the most effective periodization model is yet to be determined for many training programs (Ullrich et al. 2016, Pelzer et al., 2017). This study compared traditional (TP) and daily undulating (DUP) periodization on muscle strength, jumping performance, electromyographic-estimated neural drive and muscle architecture during pre-season loaded jumping training.
Methods
Twenty-two regional elite amateur athletes from different team sports (age: 24.3 ± 2.6 years, height: 175.9 ± 7.5 cm, body mass: 72.2 ± 8.4 kg, 12 males/10 females, strength training experience: 5.1 ± 2.2 years) performed 6 weeks of loaded countermovement jumping (18 sessions) during which subjects arranged the experimental training loads with either TP or DUP. Therefore, loading conditions corresponding to 0%, 15% and 30% of individual body mass were used by manipulating weighted training vests and the loading zones and training volume were equated between the groups. Pre-to post-training, center of mass (COM) maximal countermovement jumping performance, isometric maximal voluntary contractive capacity of the leg extensors (MVC), electromyographic-estimated neural drive of knee extensor muscles, and vastus lateralis (VL) and rectus femoris (RF) muscle architecture were examined. Therefore, biomechanical laboratory testing including force plate analysis, surface electromyography and ultrasonography was performed.
Results
Repeated measures multivariate analysis of variances (MANOVA with factors: time * training group) revealed moderate (5-16%) but significant ($p<0.05$) temporal increases in COM jumping height, leg extensor MVC and muscle architecture in both groups. These temporal alterations showed no significant differences between TP and DUP. In addition, manipulating weighted vests with loads ranging from 0-30% of body mass provoked only small, statistical non-significant variations in COM power production during countermovement jumping.
Conclusion
These findings suggest, that short-term loaded jumping training programs with an emphasis on the optimization of lower extremity power output might use a range of training loads and can be effectively constructed with either traditional or undulating periodization schemes.
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COMPARISON OF VERTICAL JUMPS PERFORMANCES IN PHYSICAL EDUCATION STUDENT WITH CAUCASIAN OR WEST AFRICAN ORIGINS

DRISS, T., ATTIOGBE, E., VANDEWALLE, H.

UNIVERSITÉ PARIS NANTERRE

Introduction
In some recent studies (Driss et al. 2004; Rouis et al., 2015, 2016), the relationship between countermovement jump with arm swing (CMJA) and maximal power on a cycle ergometer (Pmax) was different between Caucasians (C) and subjects with West-African origins (WA): CMJA was lower in Caucasians for the same value of Pmax and the same sport practice. In the present study, we did not only verify the possible difference in CMJA between subjects with Caucasian and West-African origins but we also tested the possibility of ethnic differences in squat jump (SJ), countermovement jump without arm swing (CMJ) and in the effects of countermovement and arm swing.
Methods
Squat jump (SJ), countermovement jump with (CMJA) and without (CMJ) arm swing were performed on a force platform (AMTI, 120 × 60 cm) by 84 male physical education students: 40 subjects with West-African origins (group WA) and 44 Caucasian subjects (Group C). The effect of countermovement was estimated from the difference between CMJ and SJ. The effect of arm swing was estimated from the difference between CMJA and CMJ.
Results

	Group WA	Group C	P	Cohen's d
CMJA (m)	0.462±0.057	0.411±0.053	< 0.001	0.795
CMJ (m)	0.385±0.059	0.357±0.045	0.018	0.399
SJ (m)	0.360±0.055	0.332±0.046	0.012	0.481
CMJ-SJ (m)	0.025±0.020	0.025±0.020	0.856	0.104
CMJA-SJ (m)	0.102±0.018	0.080±0.026	< 0.001	3.291
CMJA-CMJ (m)	0.077±0.016	0.054±0.025	< 0.001	4.785

Discussion
The present study confirmed the higher value of CMJA previously observed in subjects with West-African origins and indicated that the arm swing effect was more important in this group. The effects of ethnic origins were also significant for SJ and CMJ. In contrast, the effect of countermovement without arm swing was not different between ethnic groups. A higher value of the maximal power of lower limbs could partly explain the higher value of SJ.
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Contact
tarak.driss@u-paris10.fr

SPRINT MECHANICAL PROPERTIES OF FEMALE AND DIFFERENT AGED MALE SOCCER PLAYERS

BAUMGART, C., FREIWALD, J., HOPPE, M.W.
UNIVERSITY OF WUPPERTAL

Introduction
In soccer, accelerated sprint running is a fundamental part of the multifactorial performance. Therefore, high horizontal ground reaction forces are required to accelerate the body in the forward direction. While it is difficult to measure such forces directly, an innovative inverse dynamic approach (Samozino et al. 2016) allows to calculate mechanical properties from timing gate data assessed during straight-line sprint tests. This study investigated sprint mechanical properties of female and different aged male soccer players.
Methods
A total of 115 different aged male and 14 adult female soccer players were tested for body height and mass, and 30 m straight-line sprint performance on artificial turf. Male players belonged to teams of under 12, 13, 14, 15, 17, 19, and 23 years as well as to professionals (PRO). For each player a velocity-time curve was modelled using the timing gate data (5, 10, 20, and 30 m), as previously described (Samozino et al. 2016). Therefrom, the linear force-velocity and parabolic power-velocity data as well as the theoretical maximal running velocity (vmax), horizontal force (Fmax), and power output (Pmax) were calculated. A one-way between-groups ANOVA with post-hoc tests, applying Bonferroni corrections, were used to estimate differences between teams.
Results
The ANOVA revealed significant differences between teams in all anthropometric and mechanical properties ($P<0.05$). From U12 to PRO, a linear increase was found in vmax (6.6±0.4 to 8.3±0.2 m/s), Fmax (416±90 to 1031±94 N), and Pmax (701±209 to 2173±224 W). However, relative to body mass, the increase in Fmax and Pmax stagnated from U14 and U17 players, respectively. Additionally, the velocity at Pmax increased from U12 to U19 (3.3±0.3 to 4.3±0.2 m/s) and stagnated thereafter. The anthropometric and mechanical properties of females were comparable to those of the male U14 and U15 (vmax 7.1±0.2 m/s; Fmax 677±120 N; Pmax 1217±222 W; v at Pmax 3.6±0.1 m/s).
Discussion
The assessment of sprint mechanical properties can provide new insights into the sprint performance of female and different aged male soccer players, which may help to further optimize training regimes, for example, to develop talented junior toward prospective professional players. Since the differences between both genders in soccer were comparable to those of world-class sprinters (Slawinski et al. 2017), gender-specific sprint performance may be related in soccer rather to biomechanical factors than to the training status.
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Oral presentations

OP-SH11 Development of youth football players

TALENT DEVELOPMENT IN FOOTBALL: THE SPECIALISED SAMPLING MODEL

SIEGHARTSLEITNER, R., ZUBER, C., ZIBUNG, M., CONZELMANN, A.
UNIVERSITY OF BERN

Introduction
Optimizing the learning environment for young players is crucial within talent development in football. According to this, there is an extensive debate on the specificity of practice in the context of early sport participation up to 12 years of age. Is it beneficial to specialize in one sport-specific domain or does sampling through several kinds of sport lead to superior experiences (Côté & Erickson, 2015)? Asking Swiss junior national team (JNT) players, Zibung and Conzelmann (2013) have shown that a sport-specific focus within early sports participation induces a superior senior skill level. However, as only around 0.2% per cent of players are able to reach JNT levels, it would be interesting if early sport-specific practice also boosts the chances to even participate in this important elite development program.
Methods
By means of retrospective questionnaires 294 regional players (57 JNT players within; 19.4%) have been questioned about their early sport participation up to 12 years of age. Using the amount of in-club practice, free play (both in football), sports activities besides football and the age at initial club participation, a hierarchical and partitioning cluster analysis was executed. Afterwards transitions to JNT have been counted and compared to expected transitions (Fisher Test; $p < .05$) for each cluster.
Results
A five-cluster solution was identified. Whilst football abstainers (0.4-fold chance; $p = .02$) with less practice had a reduced chance, football enthusiasts (2.0; $p = .03$) with a high amount of sport-specific practice (in-club and free play) moved to JNT at a significantly increased number. In between club players (1.5; $p = .05$), average players (0.9; $p = .31$) and poly-sportive players (0.8; $p = .42$) do not show any differences from random transitions.
Discussion
On overall, we conclude that the chance for a selection to JNT increases with the amount of sport-specific practice. However, this is no claim for focused deliberate practice. In contrary: The football enthusiasts with a huge amount in free play support the hypothesis that a broad range of forms (e.g. futsal, beach soccer etc.) and settings (e.g. free play, coach-led practice etc.) within early sport-specific football practice may lead to superior performance in the later career. As this is in line with the renewed understanding of the sampling hypothe-

sis, which states that sampling is also possible within one sport-specific domain (Côté & Erickson, 2015), we claim a new insight: the specialized sampling model.

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Contact
roland.sieghartsleitner@ispw.unibe.ch

UNDERSTANDING PLAYER PROGRESSION FROM YOUTH LEVEL TO SENIOR ENVIRONMENTS IN PROFESSIONAL FOOTBALL: A COACH PERSPECTIVE

RØYNESDAL, Ø., TOERING, T., GUSTAFSSON, H.

NORWEGIAN SCHOOL OF SPORT SCIENCES

Introduction
One of the key stages in the development of elite young footballers is the within-career transition from youth level to senior professional football (Richardson, Relvas & Littlewood, 2013). The context of professional football, often male-only environments, have been described as authoritarian, ruthless and hyper-masculine (Roderick, 2006), as well as traditional, conservative, resistant to change and suspicious of outsiders (Nesti, 2010). Indeed, a cultural 'gap' between the first team level and youth level have been reported (Relvas, Littlewood, Nesti, Gilbourne & Richardson, 2010). At first team level, young elite players have described difficulties gaining approval and respect from senior players and first team management (Finn & McKenna, 2010), and they appear to struggle to integrate themselves due to the win-at-all-costs-culture in the environment (Bullough & Mills, 2014).
To bridge the cultural 'gap' between youth and first team level, this study aimed to explore; a) sociocultural features of the first team environment perceived to be associated with player progression; b) the ways in which young players can manage these features; and c) how coaches operate to assist young players during the youth-to-senior transition.
Methods
Semi-structured interviews were carried out with eight elite development coaches in the academies of English Premier League football clubs. A hierarchical content analysis was used to analyse the interview data inductively.
Results
The analysis generated two higher-order categories; fitting in with standards of first team environment (e.g. integrating with senior professionals) and interacting with stakeholders in first team environment (e.g. communicating with first team staff).
Discussion and Conclusion
To successfully progress in the transition to professional football, the findings indicate the need for young players to conform to player-based expectations and demands using self-presentational strategies, whilst adapting to sport and non-sport related principles of the first team manager. However, to succeed with the latter, it could be necessary for young players to break with certain player-induced expectations in the first team environment on a temporary basis. To achieve this, informational support from elite development coaches seemed to facilitate the process of integration for young players in the first team culture.

YOUNG AUSTRALIAN FOOTBALLERS' EXPERIENCE OF ROLE STRAIN IN THEIR DRAFT YEAR

SAUNDERS, J., PINK, M.

AUSTRALIAN CATHOLIC UNIVERSITY

Introduction
Wylleman and Lavallee's (2004) developmental perspective of transitions faced by athletes identifies the transition into elite sport as typically occurring around 18 and 19 years. This is also when the young athlete experiences key transitions in his psychological development – from adolescence to adulthood and in his academic /vocational development as he completes the secondary years of schooling. This is a critical time given its significance in achieving the foundation for a successful dual career. As part of a larger study addressing the optimal age for the player draft, this study looked at the role strain experienced by young Australian Football Players.
Methods
Eighty-three players competing in the 2015 National Under18 championships were included in the study. Participants completed an online survey which included the subscales 'overload in school' and 'overload between sport and other roles' from the Role Strain Questionnaire for Junior Athletes (RSQ-JA;Van Rens et al, 2016). These data were then compared with athletes' success/lack of success in being drafted at the end of the year. Chi squared tests of significance were conducted and odds ratios calculated to examine the influence of role strain on the likelihood of becoming drafted.
Results
The players in total expressed that they perceived some overload from their sport and between other roles and a little less from the demands of school. There was a moderate level of agreement with the idea that they could be performing better at school were it not for the demands of their football. The analysis of how perceptions of role strain related to success in the draft, showed that those who least perceived overload in their sport were 5.81 time more likely to be drafted and those who perceived least overload from the demands of school were almost three times more likely to be drafted.
Discussion
Taken at face level these results suggest that elite young footballers completing senior high school studies in their draft year of were more likely to become drafted if they experienced lower levels of role-strain. Explaining these findings however requires further research. It is tempting to suggest that successfully limiting role strain is related to well-developed personal attributes and capacities such as conscientiousness, well developed self-concept and time management skills. However, an elite athlete could equally be accepting underperformance in the school domain in order to pursue his/her sporting goals. Such strategies would have negative implications for later transitions particularly into retirement.

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HOW TO FACILITATE SOCCER ACTIVITY OUTSIDE OF ORGANIZED TEAM TRAININGS? RELATIONSHIPS WITH AUTONOMY-SUPPORT AND BASIC PSYCHOLOGICAL NEED SATISFACTION.

GJESDAL, S., OMMUNDSEN, Y.
NORWEGIAN SCHOOL OF SPORT SCIENCES

Introduction
A youth soccer training session in itself may not amount to daily physical activity guidelines (Leek et al., 2011). Furthermore, research found that elite and non-elite youth players differ in the amount of play done outside of team training sessions (Ford, Ward, Hodges & Williams, 2009). As such, it is important to stimulate additional soccer activity, both from a health and talent development perspective. Therefore, the aim of this study was to investigate the relationships between perceptions of coach autonomy-support, basic psychological needs and the frequency at which youth players engage in additional soccer activity outside of training sessions.
Methods
We employed structural equation modeling to test a two-wave half-longitudinal study to see if basic psychological need satisfaction mediated the relationship between coach autonomy-support and additional soccer play across a competitive season. This allowed us to control for previous levels while examining the influence on the change variance of the mediator and the outcome (Little, 2013). The sample consisted of 527 youth soccer players, aged 11-15 years, taking part in the Norwegian arm of the PAPA-project (Duda et al., 2013).
Results
Results revealed moderate to strong temporal stability for all three needs and the frequency of additional play. Furthermore, a positive relationship between T1 autonomy and T2 additional play; however, no other significant paths emerged. Thus, no support for temporal links between autonomy-support and any of the needs were found, and neither competence nor relatedness was related to the frequency of additional soccer play.
Discussion
The findings suggest that satisfying the need for autonomy in organized youth sport can stimulate players to engage in additional activity, underlining the notion that autonomy need satisfaction energizes behavior.
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Contact
siv.gjesdal@nih.no

THE IMPACT OF A PRE-MATCH VIDEO INTERVENTION ON PERFORMANCE AND PSYCHOLOGICAL VARIABLES IN ELITE YOUTH FOOTBALL

MIDDLEMAS, S., HARWOOD, C.
LOUGHBOROUGH UNIVERSITY

Introduction
Video feedback (VFB) is widely used among coaches, athletes and sport scientist practitioners as a valuable learning tool within the high performance sport environment. Video self-modelling (VSM) is one form of VFB where the athlete's performance is edited to show only adaptive behaviour (Dowrick, 1999) and has been linked to positive psychological benefits and performance. The aim of this study was to examine the impact of a personalised VSM intervention on performance and psychological variables within a real-life elite sporting environment.
Methods
A personalised VSM (positive self-review) intervention – based on the tenets of self-modelling theory – was delivered to four elite youth football players over a competitive football season. A multiple-baseline, repeated measures single-subject design was used to explore the impact of the intervention on subcomponents of performance and selected psychological variables (self-efficacy, positive/negative affect, thought processes). Qualitative measures (think-aloud protocol) and social validation interviews were also employed to understand the impact of the intervention on each participant.
Results
Visual inspective of the performance data indicated that positive changes were observed on selected subcomponents of performance for three of the four players who received the video intervention, while little or no impact was observed for other subcomponents. Two-tailed independent-sample t-tests indicate that significant changes occurred between pre- and post-intervention for only two of the participants (P1 Turns, P3 Headers/Tackles ($p<0.05$). Changes were also observed on psychological variables (self-efficacy and affect) for some players.
Discussion
The findings of the present study suggest that individually-tailored video interventions can lead to improvements in performance for some players. While self-modelling videos appear to some hold benefit as a performance or psychological enhancement strategy (e.g. Tracey, 2011), the findings generally reflect the mixed findings for video feedback reported elsewhere in the social science literature (Ste-Marie et al., 2012). The players did report the benefits of using psychological skills - music, imagery and self-regulation – in combination with video to aid their psychological preparation for performance. In conclusion, advancements in technology open up the accessibility of video feedback as a psychological preparation strategy for coaches and players.
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Invited symposia

IS-SH07 Volition in Sport and Physical Activity

VOLITION, PERSONALITY AND SPORT PERFORMANCE

BECKMANN, J.

TECHNICAL UNIVERSITY MUNICH

When speaking of volition we refer to auxiliary (usually meta-) processes that aid an individual in generating or maintaining a state that is optimal for the individual's interactions with the environment. This involves the control of thinking, emotion, attention, and concentration. These control processes help an individual to maintain and effectively perform an action. These auxiliary processes are required and hence activated, whenever the situation involves adverse conditions (external or internal barriers or obstacles) that cannot be mastered by motivation processes alone. The personality disposition of action vs. state orientation affects the efficiency of volition. Several studies show that this personality disposition influences many aspects of sport performance including arriving at and maintaining an optimal state for performance, control of resource allocation during competitions as well as coping with failure and stress.

VOLITION IN THE PHYSICAL ACTIVITY CONTEXT: MEASUREMENT OF VOLITION AND ITS IMPORTANCE FOR KEEPING UP REGULAR EXERCISE

ELBE, A.M., ELSBORG, P., DANDANELL, S., WULFF HELGE, J.

UNIVERSITY OF COPENHAGEN

In order to research the importance of volition for physical activity a suitable measurement instrument for this specific context is necessary. Since such an instrument so far did not exist, this presentation will focus on the development of a new instrument, namely the Volition in Exercise Questionnaire (VEQ; Elsborg et al., 2017), which assesses six volitional factors related to physical activity. The six VEQ factors show good convergent validity, test-retest reliability, and reasonable to good internal consistency. In a second step, results from a study applying this questionnaire to investigate the volitional skills of individuals with obesity (n= 164) attending an intense three month lifestyle intervention conducted at a Danish folk high school will be presented. The intense lifestyle intervention involves reduced calorie intake, daily physical activity as well as education about a healthy lifestyle. The participants' volitional skills were assessed prior to the course and their weight and physical activity levels were registered regularly up until one year after course completion. The study results indicate that volitional skills seem to be an important component in the upkeep of regular physical activity and for weight maintenance after an intense lifestyle intervention.

STRENGTH MODEL OF VOLITION

ENGLERT, C.

UNIVERSITY OF BERN

This talk provides an overview of the theoretical model of volition as relying on a limited energy source. The human body acts as if volition (including self-control, decision making, and active initiative) consumes a limited resource, thus producing 'ego depletion' effects in which top-down mental and physical control is relatively poor after prior exertion.
Abundant evidence fits this model, depicting the energy as a domain-general resource. Challenges arise because the depleted state can be overcome in various ways (though mild depletion is much easier to counteract than more extensive depletion), and because the body has ample stores of physiological energy. New formulations propose integrative solutions. Volitional depletion is a critical factor in sports. Sport performance has high demands for volition. Moreover, studies show that volition is depleted during sport performance. The interface between physical exertion and self-control is ripe for further research.

Oral presentations

OP-PM38 Health and physical activity in different conditions

CROSS-SECTIONAL AND LONGITUDINAL ASSOCIATIONS BETWEEN DIFFERENT EXERCISE TYPES AND FOOD CRAVINGS IN YOUNG ADULTS

DRENOWATZ, C.1,2, EVENSEN, L.H.3, ERNSTSEN, L.3, BLUNDELL, J.E.4, HAND, G.A.5, SHOOK, R.P.6, BLAIR, S.N.2

1: PHV (FELDKIRCH, AUT), 2: USC (COLUMBIA, SC, USA), 3: NTNU (TRONDHEIM, NOR), 4: UL (LEEDS, UK), 5: WVU (MORGANTOWN, WV, USA), 6: CMHC (KANSAS CITY, MO, USA)

Introduction
Exercise is associated with a range of health benefits, including weight management. Exercise interventions, however, commonly show less than expected weight loss, which could be attributed to a compensatory increase in food intake due to alterations in food cravings. The aim of this study, therefore, was to examine cross-sectional and longitudinal associations between habitual exercise participation and food cravings in young adults.
Methods
A total of 417 adults (49% male, 28±4 years) provided valid data at baseline and 258 participants (52% male) could be included in the longitudinal analyses. Frequency and duration of aerobic, resistance, and other exercise (min/week) were reported every 3 months. Food cravings were assessed via the validated Control of Eating Questionnaire at baseline and 1-year follow-up. Associations between exercise participation, sex and food cravings were examined via MANCOVA, adjusting for social desirability and social approval as well as baseline exercise in the longitudinal analyses.
Results

Women reported more frequent cravings for chocolate and a greater difficulty to resist food cravings compared to men ($p<0.01$). Cross-sectional analyses showed significant sex by exercise interaction effects for cravings for fruits, difficulty to resist eating and eaten in response to food cravings with resistance exercise ($p<0.05$); exercise participation was associated with favorable responses in men while resistance trained women reported higher food cravings. Further, aerobic exercise was associated with a greater likelihood to eat in response to food cravings and participation in other exercise was associated with a greater difficulty to resist food cravings ($p<0.05$). Longitudinal analyses revealed a significant sex by other exercise interaction effect for difficulty to control eating ($p<0.05$) with favorable results in men but not women. An increase in resistance exercise and total exercise was associated with a reduced difficulty to resist food cravings and a decline in eating in response to food cravings, respectively ($p<0.05$).
Discussion
Participation in various exercise types potentially affects the urge to eat. Cross-sectional results indicate a greater difficulty to resist food cravings in exercisers, particularly in women. This may be attributed to increased energy needs. An increase in exercise dose or starting an exercise program, however, was associated with an increase in appetite control, which could facilitate weight maintenance and long-term weight management.
Contact
clemens.drenowatz@ph-vorarlberg.ac.at

ABILITY OF PYSCHO-SOCIAL VARIABLES TO EXPLAIN PHYSICAL ACTIVITY PATTERNS OF INDIVIDUALS TRANSITIONING INTO UNIVERSITY.

LE ROSSIGNOL, P., SAUNDERS, J., BOERTIEN, M., WU, H.
AUSTRALIAN CATHOLIC UNIVERSITY

Introduction
This study aims to examine ways in which students can maintain physical activity involvement in the period of lifestyle transition from secondary schooling to university.
Methods
780 students commencing their studies in the health faculty at a metropolitan campus were the participants. Psycho-social variables previously identified as being supportive of physical activity involvement were measured by means of the Exercise Self Efficacy scale (Marcus et al., 1992), Social support for Physical Activity scale (Sallis et al., 1987), the Situational Motivation scale (Guay, Vallerand, & Blanchard 2000) and the Exercise Enjoyment scale (Kendzierski and DeCarlo, 1991). Physical activity was measured by means of the self-report Physical Activity Index (PAI). The ability of individual scales and variables to discriminate between broad levels of physical activity within the whole sample was first assessed by means of ANOVA. Logistic regression was then used to model the effect of the combined variables on levels of physical activity for both males and females separately.
Results
Higher levels of exercise self-efficacy, exercise enjoyment, social support from friends and family together with the motivational measures of intrinsic motivation and identified regulation and lower levels of amotivation were all found to be related to higher levels of self-reported physical activity. The model which best predicted membership of the high or low physical activity group for females included exercise self-efficacy, exercise enjoyment and social support from family and friends. For the males the model included exercise enjoyment, social support from friends and intrinsic motivation.
Discussion
There were different determinants of Physical activity levels between males and females. Females' involvement with higher levels of physical activity was predicted by measures related to their past experiences with physical activity rather than any of the motivational variables. For the males intrinsic motivation was added to factors related to past experiences. These findings have implications for the ways in which secondary school physical educators can better prepare both male and female students for continuing in health-supporting physical activity as they make the transition to a tertiary level of education.
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RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND PHYSICAL PERFORMANCE IN BLACK AFRICAN WOMEN FROM A LOW RESOURCED ENVIRONMENT: B-HEALTHY STUDY

MOSS, S.J., PHIDZA, M., OVIEDO, G.R., TAMULEVICIUS, N., MADISE, C., CZYZ, S.H.
NORTH-WEST UNIVERSITY

Introduction
Aging is associated with a decrease in physical activity (PA) and physical performance. Regular PA that includes activities of muscle strength, muscle endurance, balance and co-ordination improve physical performance, which is associated with a reduced risk of falling. It is however, unclear what the relationship is between physical performance indicators and objectively determined physical activity. To assess the relationship between objectively determined physical activity and physical performance in black African women from low socioeconomic communities in South Africa.
Methods
A group of 179 black African women from a low recourse public health setting in Ikageng, Potchefstroom (North West Province, South Africa) signed informed consent to participate in the study. Demographic information including age, body mass, education level and house hold income was recorded. Physical activity levels were assessed by combined heart rate and accelerometer (ActiHeart) over 7 consecutive days. Physical performance was determined with hand grip strength, 30 seconds Sit-To-Stand test, Static balance by Single

Leg Stand test and Timed Up and Go test for agility. Partial correlation, adjusted for age, between physical activity and physical performance components was done.
Results
The mean age of the participants were 59 ± 13 years and the average physical activity level 1.5 ± 0.24. A high level of significance between physical activity level (PAL) and single leg stand (SLS) was observed (r = 0.76, P= < 0.01). Moderately significant relations were also found between total activity energy expenditure (AEE) and SLS (r= -0.18, p=0.04), and activity frequency of light intensity (min/day) and single leg stand (r=-0.17 , p=0.05).
Discussion
This study showed that an increase in habitual physical activity improves the balance in black women from a low resourced community in South Africa. Through improved physical activity, the potential to reduce the risk of falling can be addressed.

GOOD PRACTICES IN ADAPTED PHYSICAL ACTIVITY FOR CANCER PATIENTS AND SURVIVORS: OPINION OF THE RAVIVA PROGRAM PARTICIPANTS

ROMPEN, J., SCHARFF, J., CLOES, M.

UNIVERSITY OF LIEGE

Introduction
The Belgian Foundation against Cancer proposes an adapted physical activity (APA) program for cancer patients and survivors, called Raviva (http://www.cancer.be/raviva-bouger-pour-se-sentir-mieux).The activities are supervised by instructors with inconstant trainings and experiences. Contrary to other countries, Belgian APA instructors do not necessarily need to follow specific education programs such those proposed by the ACSM (Schmitz et al., 2010) or other organizations that propose exercise guidelines for cancer survivors. The aim of this study was to identify good practices in APA for cancer patients and survivors concerning activity characteristics and instructors behaviors, from the point of view of the Raviva program participants.
Methods
Firstly, an online questionnaire was submitted to Raviva participants; 72 of them filled it in. Secondly, 3 video-stimulated recall interviews were conducted after 3 different Raviva sessions (fitness, yoga and aqua-aerobics), each time with another participant.
Results
The sessions characteristics that participants like the most are related to the choice and quality of the proposed exercises (22% of responses) and to the perceived benefits of the activities (20%). The most appreciated qualities for an instructor are related to his/her human qualities (43%) and his/her expertise (32%). What participants like least about the sessions is a poor organization (27%) and what they like least about the instructors is linked to bad choices of exercises (18%). The video-stimulated recall interviews confirmed these data and provided more precision.
Discussion
Finally, we noticed that differences in responses were observed depending on the type of activity participants took part in. These findings could help instructors adapt their practices to their participants' needs in order to promote adherence to physical activity among this population.
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Contact
jerome.rompen@ulg.ac.be

09:45 - 11:15

Invited symposia

IS-SP03 Achieving top performance AND injury prevention in football: from science to practice - Sponsored by Aspetar

WORKLOAD MONITORING, PERFORMANCE ENHANCEMENT AND INJURY RISK

NASSIS, G.

ASPETAR

Workload monitoring has been used for many years in individual sports as a means to optimize athlete's fitness and minimize the risk of muscle injury. This practice is relatively new in football. Following the introduction of the Rate of Perceived Exertion (RPE) in football, this (RPE) is the most popular method across different levels of play (Casamichana et al., 2013; Malone et al., 2015). RPE scale is not without limitations and this should be taken into account when planning a workload monitoring strategy. At high level football both external and internal load measures are collected and a plethora of variables is analyzed (Akenhead and Nassis, 2016). Perhaps, this plethora of variables prevents the sports scientists from focusing on what is really important. This lack of work efficiency highlights the need for a consensus, which does not exist, on the most appropriate tools to be used for workload monitoring in elite football (Nassis and Gabbett, 2017). The aim of this presentation will be to: 1) critically present the current practices in workload assessment in football, and 2) discuss an evidence-based applied, integrated model and workflow on training load and wellness assessment in football players. Initially, the methods for the internal and external load assessment will be discussed and some challenges in data interpretation will be highlighted. For instance, although the RPE-based training load assessment is very popular one should acknowledge that it is a subjective rating scale and external factors, like the opponent's level and the previous match result, might affect the outcome (Brito et al., 2016). Other tools such as heart rate and GPS-derived parameters are also used but so far there is no clear evidence as to which is the best one to quantify training load. Following these points, the association of workload with injuries will be discussed. Finally, an integrated model for the

assessment of players' readiness to play will also be presented. This model and the data interpretation of workload monitoring will be discussed in the context of football match, a highly complex activity (Paul et al., 2015).

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Contact
George Nassis [georgenassis@gmail.com]

PSYCHOLOGICAL PREDICTORS OF INJURIES IN TEAM SPORTS

PODLOG, L.
UNIVERSITY OF UTAH

Over the past 20 years empirical evidence has mounted demonstrating the link between psychological factors and injury risk. The aim of this presentation is to: 1. highlight key assumptions of the Williams and Andersen (1998) Stress-Injury Model which has guided the bulk of empirical enquiry; 2. discuss findings from original research testing assumptions of the Stress-Injury Model; and 3. overview psychological interventions aimed at injury reduction. According to the Stress-Injury Model, injury vulnerability is contingent upon the extent to which an athlete experiences a stress response when entering into a potentially stressful situation (e.g., a demanding competition or team selection). The stress response is comprised of an individual's cognitive appraisal of a potentially stressful athletic situation and the attentional and physiological aspects of stress. Debilitating attentional (distraction, peripheral narrowing) and physiological changes (muscle tension, fatigue, reduced timing and coordination) are proposed to occur when an athlete appraises an athletic situation as threatening (Williams & Andersen, 1998). Three broad categories of variables – personality traits, history of stressors, and coping resources – are also suggested to influence the strength of the stress response and the subsequent likelihood of injury. Empirical work has consistently supported assumptions espoused in the Stress-Injury Model. A Meta-analysis by Ivarsson and colleagues (2016) demonstrated that the stress response (r = 0.27, 80 % CI [0.20, 0.37]) was the strongest predictor of injury. Specifically, under stressful conditions, athletes may experience a narrowing of their peripheral vision which inhibits their ability to process environmental cues, and which increase their risk of acute injury. Furthermore, personality traits (high trait anxiety), a history of life stressors (high life stress, previous injury), and poor coping resources (low social support) have been linked with increased injury risk (Podlog & Heil, 2012). Cognitive behavioral interventions focused on stress management and relaxation techniques have demonstrated a large effect on reducing the number of injuries among athletes. Tranaeus et al. (2015), showed a total Hedges' g effect size of 0.82 (P < .001), 95% CI (0.55-1.11), suggesting a substantial impact. Illustrating the considerable influence of psychological interventions on injury reduction, Johnson et al (2005), experimentally demonstrated that a stress reduction training program significantly reduced injuries in treatment group athletes (three injuries; 0.22 per athlete) compared to controls (21 injuries; 1.31 per athlete). In sum, the Stress-Injury Model appears to be a valuable framework for examining injury antecedents for acute sport injury. Furthermore, psychological factors – in particular the stress response – appear to increase the risk of acute injury. Finally, psychological interventions have shown promise in reducing the stress response and subsequent likelihood of injury.

AN INTEGRATED SPORTS MEDICINE AND SPORTS SCIENCE APPROACH FOR INJURY AND DISEASE PREVENTION IN FOOTBALL: THEORY AND PRACTICAL APPLICATION

MEYER, T.
SAARLAND UNIVERSITY

Injuries and diseases are responsible for time loss in elite and recreational football (i. e. the failure to take part in training or competition). Two key physiological factors have been identified that predict an increased likelihood of injuries: age and previous injuries, both hard to manipulate. Additionally, there is indication that appropriate training monitoring as well as high-quality interactions among staff members may play a preventive role. The avoidance of undue fatigue is similarly considered a protective factor for infectious diseases. On the other hand, approaches designed to predict injury proneness on the basis of testing players´ functional properties have failed to predict injury occurrence. This situation leaves us with few tools to utilize in a targeted manner. Given the perception of many practitioners that a high degree of individualization is necessary, several strategies for that purpose will be discussed. Despite the unsatisfactory panel of injury and disease predictors, various programmes and strategies have been developed which can be used without the need to tailor them to the individual player. Initial studies outside of football have examined disease prevention primarily on the basis of appropriate hygiene measures. Their success is surprisingly good and they may therefore provide the basis for football-specific strategies. The most widely tested injury prevention program is probably F-MARC´s 11+ which has also been extended to children´s football. This programme may serve as a model to create similar prevention measures for which the probability of success is high. Several elite teams already follow this path.

Oral presentations

OP-PM52 Nutrition and supplements 2

DIETARY NITRATE SUPPLEMENTATION DOES NOT IMPROVE CYCLING TIME-TRIAL PERFORMANCE IN THE HEAT

KENT, G.L.1, DAWSON, B.1, COX, G.R.2, BURKE, L.M.2, EASTWOOD, A.2, CROFT, K.D.1, PEELING, P.1,3
THE UNIVERSITY OF WESTERN AUSTRALIA

Introduction

Beetroot juice (BR), a source of dietary nitrate (NO3-), has been shown to improve tolerance to high-intensity exercise [1] and cycling time-trial (TT) performance [2,3]; however, its ergogenic effect in a hot environment has not been extensively investigated. This investigation examined the effect of BR supplementation on cycling performance and thermoregulation in the heat.
Methods
In a double-blind, repeated measures cross-over design, 12 male cyclists (age 25.0 ± 4.3 y, VO2peak 65.8 ± 5.4 mL/kg/min) completed four cycling TTs (14kJ/kg) in hot (H) (35°C, 48% RH) and euthermic (E) (21°C, 52% RH) conditions. Athletes were supplemented for 3 days with NO3--rich BR, or NO3--depleted BR placebo (PLA), consumed at a rate of 9.6 mmol NO3- per day for 2 days, and 19.2 mmol NO3- 2 h prior to the cycling TT. All participants were provided with a standardised 24 h pre-trial diet. Salivary NO3- and nitrite (NO2-) was measured PRE- and POST-supplementation. Core (Tc) and mean skin temperature (Tsk), heart rate (HR), ratings of perceived exertion (RPE) and thermal sensation (RPTS) were measured during each TT.
Results
Salivary NO3- and NO2- increased POST BR compared with PRE ($p<0.001$). Average TT completion time was 1 min 40 s (2.7%) faster in BR-H ($p=0.18$), and 52 s (1.5%) faster in BR-E ($p=0.38$) compared with PLA. The Tc and mean Tsk were higher, and TT completion time slower in H compared with E ($p<0.05$). No significant differences were seen in Tc, Tsk, HR, RPE or RPTS between BR and PLA.
Discussion
Three days of BR supplementation is not significantly beneficial or detrimental to cycling performance in the heat; however, marginal (non-significant) performance gains were observed when BR was consumed. The 1.5% and 2.7% performance improvements are similar to those observed in previous BR studies into BR supplementation and TT performance, while also considering that this TT was performed over a longer duration [2,3].
Moreover, the absence of a change in Tc, despite the marginally quicker TT times with BR, suggests a possible improvement in thermodynamic efficiency, but further research is required to explore this possibility.
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Contact
georgina.kent@research.uwa.edu.au

BREATH CARBON STABLE ISOTOPE RATIOS AS A POTENTIAL BIOMARKER OF ENERGY INTAKE AND ENERGY BALANCE STATUS

HORNER, K.M., BYRNE, N.M., KING, N.A.

UNIVERSITY COLLEGE DUBLIN

Introduction
Breath carbon stable isotope ratios (breath δ13C) have recently been reported as markers of changes in energy intake (EI) and balance (EB) in humans in a proof-of-concept study (1). This method may therefore represent a promising non-invasive tool, with a number of potential applications in health and exercise science research. The aims of the present investigation were to determine (1) the reproducibility of the natural abundance of exhaled breath carbon stable isotope ratios (breath δ13C) in humans, and (2) breath δ13C's associations with energy intake (EI), expenditure (EE) and energy balance (EB).
Methods
For study 1, 15 overweight and obese men completed two identical tests, 7 days apart, and were instructed to consume the same foods and to minimise exercise on the day prior to both test days. For study 2, a cross-sectional study was undertaken in 44 men (n=22 active, n=22 inactive). Resting EE was measured by indirect calorimetery and activity EE was measured by accelerometery over 7 days prior to breath sampling, and used to estimate total daily EE (TEE). Average daily EI was assessed by multiple pass 24h diet recall on 3 occasions across the same 7-day period. EB was calculated as the difference between EE and EI. In both studies, participants were instructed to avoid consumption of the highest naturally occurring 13C foods for 2 days prior to testing to minimise background variation. Breath samples were given in duplicate following a 12-hour overnight fast and subsequently analysed by isotope ratio mass spectrometry.
Results
Intra-individual CV for breath δ13C was 2.8%, demonstrating good reproducibility within individuals between the two identical test days. In Study 2, fasting breath δ13C was significantly lower in active compared to inactive men ($p=0.036$). When the data from the two groups were pooled fasting breath δ13C was correlated with 7day average EI ($r=0.487$, $P=0.001$) and with resting EE ($r=0.320$, $p=0.034$) and 7d average EB ($r=0.377$, $p=0.015$). There was a trend towards an association of fasting breath δ13C with respiratory quotient ($r=0.29$, $p=0.056$), but not with macronutrient composition or TEE or activity EE ($p>0.05$ for all).
Discussion
These data support the proof-of-concept acute energy balance and weight loss study by Whigham et al. (2014), and propose breath δ13C as a promising potential biomarker of EI and EB. Potential future applications could include for population studies, for weight loss interventions and for assessing and monitoring EB status.
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SEASONAL VITAMIN D INSUFFICIENCY, PHYSICAL PERFORMANCE AND INJURY INCIDENCE IN UK-DWELLING UNIVERSITY ATHLETES: PRELIMINARY DATA FROM THE D-BIICEP STUDY

WILSON-BARNES, S.1, HUNT, J.1, WILLIAMS, E.L.2, WAINWRIGHT, J.3, WILD, J.4, LANHAM-NEW, S.1, MANDERS, R.1

1SCHOOL OF BIOSCIENCES AND MEDICINE, UNIVERSITY OF SURREY, GUILDFORD. 2 IMPERIAL COLLEGE HEALTHCARE NHS TRUST, LONDON. 3 SURREY HUMAN PERFORMANCE INSTITUTE, GUILDFORD. 4 SURREY SPORTS PARK, GUILDFORD

Introduction
Vitamin D (vitD) is unique; our primary source is not diet but rather through subcutaneous sunlight exposure to ultra violet B (UVB) irradiation. Hence, athletes that train predominantly indoors or at higher latitudes could be at risk of low vitD status. Previous research suggests that vitD deficiency can be detrimental on physical performance (Dahlquist et al., 2015) but currently there is little data on vitD insufficiency within university athletes. Furthermore, it would be valuable to determine the link between vitD status, performance (muscular strength

and power, aerobic fitness) and the incidence of injury in this population. The D-BIICEP study aimed to determine whether UK university athletes are at risk of vitD deficiency and whether there was an impact upon injury and physical performance.
Methods
A total of 58 athletes (21 women and 37 men) competing in a range of sports from the University of Surrey (training ≥4 hours/week), were tested during autumn and spring to determine blood vitD status and physical performance parameters. Blood samples were analysed for serum 25-hydroxy vitamin D (25(OH)D) concentration. Muscle strength was assessed using isokinetic dynamometry (knee extension and handgrip) and muscle power using a counter movement jump. Aerobic capacity was estimated using the YO-YO intermittent test. Injury incidence was evaluated using a standardized questionnaire, administered when participants suffered an injury and during the spring term. All statistical analysis were performed using paired and independent t-testing.
Results
Serum 25(OH)D significantly fell between autumn and spring; 54.1 ± 22.7nmol/L vs. 31.5 ± 16.4nmol/L, respectively ($p < 0.001$). During autumn, 40% of the athletes were insufficient in vitD (<50nmol/L) and 7% were deficient (<25nmol/L) (SACN, 2016; EFSA, 2016). During spring 90% of our cohort were insufficient and 44% were deficient. There was no seasonal change in aerobic fitness (42.9 ± 2.5 ml/kg/min vs. 43.1 ± 2.9 ml/kg/min; $p = 0.6$) and maximal voluntary contraction (MVC) of the knee extensor (246.1± 60.6 Nm vs. 254.6 ± 68.9 Nm; $p=0.5$) and handgrip (39.1 ± 10.7kg vs. 38.9 ± 11.0kg; $p=0.8$) muscles from autumn to spring. VitD status was positively associated with knee extensor MVC ($r2=0.345$, $p=0.01$) and aerobic capacity ($r2=0.311$, $p=0.03$) during the autumn term. Ten participants reported injuries over the observational period, but initial analysis did not detect any differences between their vitD (28.4 ± 11.0 nmol/L vs. 31.8 ± 17.9 nmol/L).
Discussion
These data suggest that university athletes are at significant risk of deficiency/insufficiency during winter (Oct-Mar), particularly given that nearly half were <25nmol/L in spring. There was a positive association between lower body measurements of muscular strength, aerobic capacity and vitD status in autumn although there was no seasonal change in physical performance. These data are a cause for concern and warrant further research in the area of vitD health in university athletes living in northern latitudes.

HYDROLYSED KERATIN SUPPLEMENTATION IN PHYSICALLY ACTIVE INDIVIDUALS INCREASES LEAN BODY MASS COMPARED WITH CASEIN

STANNARD, S., MCLEAY, Y., CRUM, E., BARNES, M.

MASSEY UNIVERSITY

Introduction
Hydrolysed keratin protein is a palatable and safe protein source for humans (1) that has been shown to alter lean mass in rodents (2). However, its effect on body composition in humans has not been investigated. This study compared the effects of hydrolysed keratin (KER) or casein (CAS) protein supplementation, over and above a balanced diet, on anthropometric variables in healthy individuals during a four week period of cycle exercise training.
Methods
Fifteen male cyclists (mean ± SD; age 34.8 ± 12.2 y, mass 82.8 ± 14.9 kg, VO2max 62.7 ± 8.6 ml/min/kg) supplemented their normal diet with 0.8 g/kg body weight of KER and CAS during two four week trials. Supplements were matched for protein content and provided in a randomized, balanced blinded fashion with a minimum four-week washout period between trials. Exercise training was controlled and food intake recorded throughout each trial. Anthropometrical measures via DEXA were made prior to each trial and immediately upon cessation.
Results
There was no difference between energy content or protein content of the habitual diet compared to the training diet (without supplements) for either treatment ($p > 0.750$). The supplements provided to participants did not differ in energy ($p = 0.252$), protein ($p = 0.229$), fat ($p = 0.880$) or carbohydrate ($p = 0.338$) content. During the four week training periods, total (training diet plus supplement) energy ($p = 0.150$) and protein ($p = 0.199$) did not differ between KER and CAS treatments. The supplemented diet was significantly higher in energy and protein (both $p > 0.0001$) compared to participant's habitual diet. Total body mass, percentage body fat and bone mineral density did not change significantly (all $p > 0.05$) with either treatment. However, a significantly greater increase in bone free lean mass occurred with KER supplementation compared with CAS (0.95 kg vs 0.07 kg; $p = 0.033$). While no significant change in bone free lean mass was evident for the trunk, leg mass increased in KER (1.93 ± 2.27%, $p = 0.006$) compared to CAS (-0.64 ± 1.94%; $p = 0.645$).
Discussion
These data suggest that hydrolysed keratin may be a suitable protein supplement, compared to casein, for maximizing increases in lean body mass when prescribed alongside regular aerobic physical activity.
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Contact
S.Stannard@massey.ac.nz

A NOVEL BITTER SOLUTION CAN INCREASE SHORT-TERM POWER OUTPUT IN A 3 KM CYCLING TIME-TRIAL

ETXEBARRIA, N.1, ROSS, M.2,3, CLARK, B.1, BURKE, L.2,3

1 UNIVERSITY OF CANBERRA RESEARCH INSTITUTE OF SPORT & EXERCISE, AUSTRALIA. 2 AUSTRALIAN INSTITUTE OF SPORT, AUSTRALIA. 3 MARY MACKILLOP INSTITUTE FOR HEALTH RESEARCH, AUSTRALIAN CATHOLIC UNIVERSITY

Introduction
Track cycling includes short and very high intensity events such as the team pursuit. Maximal 30 s cycling performance can be improved by ingestion of a bitter drink (quinine)1, but it is unclear whether the effects last long enough to enhance 3 km maximal time trial (TT) performance. We quantified the effects of 2 mM quinine ingestion prior to a 3 km maximal cycling TT.
Methods
Nine well-trained male cyclists (mass 78 ± 11 kg; height 181 ± 7 cm and maximal aerobic power 386 ± 38 W; mean ± SD) performed a maximal incremental test, three 3 km familiarisation trials and four different 3 km time trials in a total of 8 separate visits to the laboratory.

The four treatments administered in a randomised and counterbalanced manner were: 1) 25 ml of water, 2) a 25 ml sweet solution (placebo) and 3) and 4) repeat 2mM quinine solutions, 30 s prior to the commencement of each trial. Each time trial was performed on a VelotronR cycle ergometer with participants being blind to power output, cadence and other feedback except for distance covered. Participants were allowed to self-select their gears and free to change gears during the time trials. Power output (W) was monitored continuously during all trials. Descriptive statistics are represented as mean ± SD and differences between the interventions are specified as standardized mean difference ± 90% confidence limits.
Results
There was no substantial ergogenic effect of quinine on 3 km TT cycling performance. Mean power output for all four conditions was similar: 348 ± 45 W (water), 354 ± 47 W (quinine1); 355 ± 47 W (sweet), and 355 ± 48 (quinine2). Quinine administration increased power output during the first km by ~18 ± 9 W over water, followed by a decay in power output in the final stages.
Discussion
It appears ingesting 2mM of quinine improves cycling performance during the first 1/3 of a 3 km TT but there is also a greater decay in power output during the rest of the TT. Quinine does not appear to improve an individual 3 km performance and might only be useful for short-term (~30s) efforts. The elevated power output during 1st km could be exploited in the team pursuit event by supplementing the lead-off rider.
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Contact
Naroa.etxebarria@canberra.edu.au

EPHEDRA ALKALOIDS CONTENT IN CHINESE HERBAL FORMULAS SOLD IN TAIWAN

CHANG, C.W., HU, S.Y., HUANG, G.Q., HSU, M.C.
KAOHSIUNG MEDICAL UNIVERSITY

Introduction
Consumption of the Ephedra alkaloids was prohibited in-competition by the World Anti-Doping Agency (WADA). Athletes are likely receiving the treatments of Chinese Herbal formulas containing Herba Ephedrae once they got cold. We aimed to screen the available products sold in Taiwan and preliminarily justify the relationship between these products and adverse analytical findings (AAFs).
Methods
Fifty-six concentrated powder products (19 Chinese Herbal formulas) containing Herba Ephedrae, used to release the exterior, treat phlegm, expel wind, and expel dampness, were confiscated. Ephedra alkaloids content, namely ephedrine (E), methylephedrine (ME), norpseudoephedrine (NPE; cathine), pseudoephedrine (PE), and norephedrine (NE; phenylpropanolamine), were determined using a validated high-performance liquid chromatographic method.
Results
The results revealed that the phenotype indicators of the collected products, E/PE and E/total ratio, varied from 1.52–4.70 and 0.49–0.72, respectively, highlighting that the species of Herba Ephedrae in these products was likely E. sinica or E. equisetina, instead of E. intermedia. The contents E, ME, NPE, PE, NE, and total alkaloids for each daily amount ranged from 0.45–34.97, 0.05–4.87, 0.04–3.61, 0.15–12.09, 0.01–2.00, and 0.68–53.64 mg, respectively. Quite consistent orders for alkaloid contents (E > PE > ME ≈ NPE > NE) were identified for these products even from different manufacturers. We also speculated that there are 48.2% and 3.6% of products would exceed WADA's thresholds of E and NPE, respectively, after single-dose consumption.
Conclusion
Our data provide critical information for athletes and medical personnel who should also be aware of these complex Chinese herbal formulas apart from over-the-counter products.

Invited symposia

IS-PM11 Resistance Training in Youth Athletes

YOUTH ATHLETE DEVELOPMENT

ARMSTRONG, N.
UNIVERSITY OF EXETER

Sport performance during youth is founded on a range of sex- age- and maturity-related morphological and physiological variables with an asynchronous transition into an adult profile. Investigations of body size, shape and composition; muscle structure, strength and metabolism; anaerobic and aerobic performance; and fatigue resistance; include data derived from a variety of conventional and emerging technologies. The data present a consistent but incomplete picture with sexual dimorphism and age-related changes in responses to exercise and training documented but independent maturity-related effects elusive to establish [Armstrong et al. 2017]. Justifications for 'early specialisation' or the presence of specific 'windows of opportunity', 'critical periods' or 'maturational thresholds' as hypothesised in well-established long-term athlete development programmes remain to be proven [Bergeron et al. 2015]. A foundation of laboratory-based paediatric exercise science has been established but the lack of rigorously designed youth sport-specific studies has clouded the interpretation of the data and the translation of laboratory research into the optimisation of youth sport performance [Balyi et al. 2013].
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YOUTH ATHLETIC DEVELOPMENT: MINIMISING RISKS AND MAXIMISING REWARDS

OLIVER, J.

CARDIFF METROPOLITAN UNIVERSITY

Participation in youth sports is known to provide a range of benefits to the developing child, with the integration of systematic training helping to promote physical development and reduce injury risk. It is now accepted that many forms of training are safe and can lead to positive adaptations that improve the performance and health of youth athletes. Evidence is starting to accumulate that suggests physical conditioning can be most successful in youth when completed at a high intensity [Armstrong et al. 2011, Lesinski et al. 2016] while strategies such as integrated neuromuscular training can be particularly effective at reducing sports injuries [Myer et al. 2011]. However, competition and training are not without risks. Early specialisation is associated with increased injury risk and burnout. Sampling a variety of sports can help to avoid these negative outcomes, but sampling alone is unlikely to fully prepare individuals for the rigours of youth sport. Injury rates continue to be high in youth sports; this may be associated with low strength and poor movement mechanics and screening can help to identify those at increased risk. The incidence of non-functional overreaching and overtraining are also prevalent across youth sports and an awareness of the cause and symptoms can allow early intervention. High training volumes, inappropriate training, insufficient recovery and a failure to properly consider growth and maturity, all present risks to the developing youth athlete. An evidence-based approach to youth athletic development should expose athletes to programs that are developmentally appropriate, provide sufficient stimulus to encourage continued positive adaptation and manage risks to avoid negative outcomes that continue to be common in youth sports.

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EFFECTS OF RESISTANCE TRAINING IN YOUTH ATHLETES ON MUSCULAR FITNESS AND ATHLETIC PERFORMANCE: A CONCEPTUAL MODEL FOR LONG-TERM ATHLETE DEVELOPMENT

GRANACHER, U.

UNIVERSITY OF POTSDAM

During the stages of long-term athlete development (LTAD), resistance training (RT) is an important means for (i) stimulating athletic development, (ii) tolerating the demands of long-term training and competition, and (iii) inducing long-term health promoting effects that are robust over time and track into adulthood [Feigenbaum et al. 2016]. However, there is a gap in the literature with regards to optimal RT methods during LTAD and how RT is linked to biological age [Granacher et al. 2016].

Thus, the aims of my presentation will be (i) to describe and discuss the effects of RT on muscular fitness (i.e., muscular strength, muscular power, muscular endurance) and athletic performance (e.g., throwing velocity in handball) in youth athletes, (ii) to introduce a conceptual model on how to appropriately implement different types of RT within LTAD stages, and (iii) to present physiological adaptive processes following RT in youth athletes.

In general, RT produces small-to-moderate effects on muscular fitness and athletic performance in youth athletes with muscular strength showing the largest improvement. Free weight, complex, and plyometric training are well-suited to improve muscular fitness and athletic performance [Lesinski et al. 2016]. In addition, balance training is an important preparatory (facilitating) training program during all stages of LTAD but particularly during the early stages. As youth athletes become more mature, specificity (sport specific RT) and intensity (heavy-resistance RT) of RT methods increase. Recent evidence indicates, that RT-induced changes in muscular fitness and athletic performance rely on enhanced neuromuscular control (particularly in child athletes) and morphological adaptations of muscles and tendons (particularly in adolescent athletes) with the bone also adapting by increasing bone mineral content and cortical area.

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Invited symposia

IS-BN02 BRAIN AND NEUROMUSCULAR FUNCTION IN OLD AGE– IMPLICATIONS FOR COGNITIVE AND MOTOR PERFORMANCE

BRAIN METRICS AND IMPAIRED MOTOR PERFORMANCE: THE EFFECTS OF AGING ON STRUCTURAL AND FUNCTIONAL INTERHEMISPHERIC INTERACTIONS

LEVIN, O.

KU LEUVEN

Introduction

Many motor related declines that older adults experience in daily life (such as longer reaction times, impaired coordination skills, and deterioration of fine motor control) could be explained by changes in structural and neurochemical properties of the aging brain. However, the exact role of the interplay between brain structure and function in the aging brain remain largely unclear.

Methods

Using a dual-site transcranial magnetic stimulation (dsTMS), we investigated interhemispheric interactions (IHI) from bilateral dorsolateral prefrontal cortex (DLPFC) and dorsal premotor cortex (PMd) onto the contralateral primary motor cortices (M1). Structural properties of these interactions were assessed with diffusion-based fiber tractography. Data were collected in young (n=15, 22.6 ± 2.6 y) and old (n=15, 66.0 ± 3.4 y) healthy participants during preparation of a bimanual coordination task with easy (1:1) and complex (1:3 and 3:1) frequency ratios.
Results
Compared to young adults, older adults showed performance declines in the more difficult task conditions, less optimal brain white matter (WM) microstructural organization between all regions of interest, and a decreased ability to regulate IHI between DLPFC and M1.
Discussion
These results reflect unique interactions between structure and function in the aging brain, such that declines in WM microstructural organization likely lead to dysfunctional regulation of IHI, ultimately accounting for bimanual performance deficits. Finally, less optimal brain white matter (WM) microstructure was associated with impaired facilitatory IHIs but not inhibitory IHIs. We argue that age-related changes in WM microstructure most likely interrupt interhemispheric glutamatergic projections between DLPFC/PMd and the contralateral M1.

NEUROMUSCULAR PROTECTIVE EFFECTS OF REGULAR PHYSICAL ACTIVITY

NARICI, M.V., BADIALI, F., FRANCHI, M.V., RANKIN, D., MONTI, E., LONGO, S., WILLIAMS, J.P., HERROD, P., LUND, J.
UNIVERSITY OF NOTTINGHAM

Introduction
Motor neuron degeneration, denervation, loss of structural and functional integrity of the neuromuscular junction (NMJ) and loss of motor units (MUs), markedly contribute to the development of sarcopenia. NMJ degeneration in sarcopenic humans may be assessed from serum measurements of c-terminal peptide agrin fragment (CAF), a breakdown product of agrin, released after NMJ damage (Hettwer et al. 2013). Recently, we reported a decrease in CAF levels in older individuals after a 6-month dancing intervention (Narici et al. 2016). This study aimed to investigate whether these neuroprotective effects are present in habitual older dancers (OD) compared to aged-matched sedentary older (OS) individuals.
Methods
Twenty OD (aged 67-87 years, 12 M and 8 F) practicing various dancing activities (sequence/morris/rapper/sword dancing) at least twice/week, 90 min, for 2 years minimum, and 15 OS individuals (aged 65-86 years, 7 M and 8 F) were recruited for this study. OD and OS were compared in terms of neuromuscular characteristics: 1) blood serum CAF levels (determined with ELISA kit, Neurotune, CH), 2) muscle structure (vastus lateralis, VL, muscle cross-sectional area (CSA) by ultrasound), 2) VL muscle architecture (fascicle length and pennation angle) by ultrasound, 3) leg extensors muscle strength (MVC) and power (Nottingham Power Rig), 4) neuromuscular fatigue (isometric contraction at 60% MVC until task failure) with EMG recordings to assess CNS fatigue (change in median frequency, MDF). Ethics approval and individual informed consent were obtained for this study. Statistical significance was tested with a Student's t-test. Data are reported as means±SEM.
Results
CAF serum level in OD were found to be 42% lower than in OS (215.9±27.4 pM vs. 369.7± 50.6 pM, $p<0.02$). Also, greater values of VL muscle thickness (+13%, 1.94±0.06 cm vs 1.72±0.11 cm and pennation angle (+8%, 14.3±0.52 deg vs 13.3±0.60 deg) were found in OD than in OS. Whereas no differences in MVC and CSA were found between OD and OS, neuromuscular fatigue (time to task failure) was significantly lower (-28%) in OD than in OS (88.4 s vs 68.8 s). EMG power spectrum analysis revealed that the lower fatigability of OD was not attributable to differences in CNS fatigue as a similar decrease in MDF at task failure was found in both groups.
Discussion
The present findings provide evidence that habitual recreational dancing exerts a protective action against neuromuscular degeneration in older individuals preserving NMJ integrity, muscle mass and neuromuscular function. We posit that dancing may afford these benefits by 1) reducing oxidative stress, 2) lowering inflammation, 3) preserving neurotrophins levels, 4) loading of skeletal muscle and 5) stimulation of the somatosensory system.
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RELATIONSHIP BETWEEN POSTURAL CONTROL AND POSTURE-UNRELATED ATTENTION CONTROL IN ADVANCED AGE

NETZ, Y.
WINGATE COLLEGE

Introduction
It has been shown that postural control (PC) is not an automatic task and is generally accompanied by posture-unrelated (PU) cognitive activity, especially in old age. While the relationship between PU cognition and cardiovascular fitness in old age is highly researched, studies assessing the relationship between PU cognition and PC are scarce.
Methods
We assessed the relationship between PU attention with PC in 112 people (34 men) aged 74.44 (±6.07). Stepwise regressions were performed with attention (Go-Nogo) as a dependent variable, and static (quiet stance in 8 sensory conditions, and Functional Reach) and dynamic balance (10m walk - time and stride length, Timed Up & Go) as independent variables.
Results
In men, Functional Reach and stability with eyes closed and head tilted explained 52% of the variance of attention, and for women aged 63-74 – stability with eyes closed and stride length explained 30.5% of the variance. In women aged 75+ the correlations were low and no variables contributed to explaining the variance of attention.
Discussion
We concluded that in men, a decrease in sensory-motor information followed by a decrease in visual information – both of these in a standing position - is related to PU attention, while for women aged <75 a decrease in visual information and performing a dynamic balance task are related to PU attention. In women, as age increases, PC becomes less related to PU attention.

Oral presentations

OP-PM27 Interventions to optimize recovery

REGULAR ACTIVE RECOVERY DURING A HIGH-INTENSITY INTERVAL-TRAINING MESOCYCLE DOES NOT ATTENUATE TRAINING ADAPTATION

WIEWELHOVE, T., SCHNEIDER, C., SCHMIDT, A., RAEDER, C., DÖWELING, A., FERRAUTI, A.
RUHR-UNIVERSITY BOCHUM, FACULTY OF SPORTS SCIENCE

Introduction
High-intensity interval-training (HIIT) can be extremely demanding and consequently can produce high blood lactate levels (Tschakert & Hofmann, 2013). Previous studies have shown that lactate is a potent metabolic stimulus, which is important for adaptation following endurance training (Wahl et al., 2010). Active recovery (ACT) after intensive intermittent exercise, however, enhances blood lactate removal in comparison with passive recovery (PAS) (Nèdèlec et al., 2012), and consequently may attenuate endurance performance improvements. Therefore, the aim of this study was to examine the influence of regular ACT on training adaptations during a HIIT mesocycle.
Methods
26 well-trained male intermittent sport athletes (age, 23.5±2.5 years; $\dot{V}O_2$max, 55.36±3.69 ml·min·kg-1) participated in a randomized controlled trial consisting of four-weeks of a running-based HIIT mesocycle with a total of 18 HIIT sessions. After each training session, participants completed 15 min of either moderate jogging (ACT) or PAS. Subjects were matched to the ACT or PAS groups according to age and performance. Before the HIIT program and one week after the last training session, the athletes performed a progressive incremental exercise test on a motor driven treadmill to determine $\dot{V}O_2$max, maximum running velocity (vmax), running velocity at which $\dot{V}O_2$max occurs (v$\dot{V}O_2$max), and anaerobic lactate threshold (AT). Furthermore, repeated sprint ability (RSA) and total haemoglobin mass (tHbmass) were determined.
Results
The HIIT mesocycle induced a small to moderate increase in vmax (Overall [OVE]: effect size [ES]=0.65, p<0.01; ACT: ES=0.62, p<0.01; PAS: ES=0.67, p<0.01), v$\dot{V}O_2$max (OVE: ES=0.62, p<0.01; ACT: ES=0.73, p<0.01; PAS: ES=0.52, p<0.01), and AT (OVE: ES=0.56, p<0.01; ACT: ES=0.84, p<0.01; PAS: ES=0.27, p=0.17), as well as a small decrease in tHbmass (OVE: ES=-0.28, p<0.01; ACT: ES=-0.27, p>0.07; PAS: ES=-0.30, p<0.01), compared with the values before the intervention. $\dot{V}O_2$max and RSA remained unchanged throughout the study. In addition, no significant recovery intervention x time interactions were noted in any of the parameters between ACT and PAS, except for AT.
Discussion
Regular use of individualized ACT, consisting of 15 min of moderate jogging following each training session, did not attenuate training adaptations during a HIIT mesocycle compared to PAS. Interestingly, we found that the ACT group obtained a significantly higher AT following the training period compared to the PAS group. This could be because ACT allows a continuation of the training at a low-intensity and may potentially activate specific adaptive mechanisms that are not triggered during PAS.
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DOES REGULAR COLD WATER IMMERSION AFTER STRENGTH TRAINING ATTENUATE TRAINING ADAPTATION? A RANDOMIZED CONTROLLED TRIAL

POPPENDIECK, W., WEGMANN, M., HECKSTEDEN, A., DARUP, A., FUHR, C., KRAUSS, K., SCHIMPCHEN, J., SKORSKI, S., FERRAUTI, A., KELLMANN, M., PFEIFFER, M., MEYER, T.
SAARLAND UNIVERSITY

Introduction
Cold water immersion (CWI) after exercise is increasingly used by athletes aiming at speeding up recovery and restoring maximum performance. However, recently indications have emerged that regular use of CWI after training might be detrimental to training adaptation. Therefore, the aim of this study was to investigate if regular CWI after strength training of the legs attenuates training adaptation. Strength training was chosen as more pronounced local training effects can be expected compared to endurance training.
Methods
In a randomized cross-over design, 10 healthy trained subjects (26±4 years, 178±9 cm, 79±13 kg) performed two cycles of 24 leg training sessions over a period of 8-9 weeks, separated by at least 2 months. Each session consisted of three machine-based exercises (leg press, leg curl and leg extension). For each exercise, three sets until fatigue at the 10-repetition maximum (RM) were performed with a break of 3 minutes. Load was determined during the first session, and was adjusted during the 13th session. In the intervention condition, the subjects performed a whole-body CWI at 12-15°C for 10 min after each session. In the control condition, no recovery intervention was applied. To assess training adaptation, the 1-RM at the leg press, as well as counter movement jump performance, were determined before and after both training cycles.
Results
For CWI, the 1-RM was increased by 2.4±7,5 kg. The increase in the control condition was 5.1±7.5 kg. The corresponding effect size (Hedges' g) between groups was 0.37, indicating a small, but not significant (p=0.30) effect. No significant differences (g=0.03, p=0.95) were found for the changes in jump performance (cooling: +0.9±2.2 cm, control: +0.8±5.4 cm).
Discussion
While CWI after exercise appears to elicit some positive effects on recovery, regular use of post-exercise cooling may attenuate training effects. This hypothesis is based on the idea that while cooling may reduce exercise-induced inflammation and thereby speed up recovery, the inflammation reaction is also a precondition for the adaptive processes yielding improved muscular performance. The present investigation does not support a significant detrimental effect of cooling on training adaptation. However, for leg press performance, a small effect size was observed, suggesting that a cooling-induced attenuation of strength training adaptation cannot be ruled out.

EFFECTS OF EXTERNAL COUNTERPULSATION THERAPY ON RECOVERY FOLLOWING A RUGBY LEAGUE MATCH.

KELLY, V.1,2, CAIA, J.1,2, ROBERTS, L.1, SCOTT, T.2

1. UNIVERSITY OF QUEENSLAND 2. BRISBANE BRONCOS RUGBY LEAGUE CLUB

Introduction
External counterpulsation (ECP) therapy, via sequential compression of the lower extremities during diastole, significantly improves long-term left ventricular function in coronary artery disease patients (Qin et al., 2016). Our pilot work showed that exercise performance was improved following acute ECP therapy and regular ECP therapy improved biochemical markers of angiogenesis and perceptual measures of recovery in elite athletes. However, the effects of ECP therapy on acute recovery markers following exercise is yet to be examined. The aim of this investigation was to examine how ECP therapy, alongside cold water immersion (CWI), influences hormonal markers of recovery and symptoms of stress following a rugby league match.
Methods
Using a cross-over design, 9 elite male rugby league players (22.3 years; 98. 3 kg) (CWI) 12 degrees C, or 15 min ECP (Renew NCP, Singapore) therapy in addition to 6min CWI, the day following a rugby league match. Salivary cortisol (C) and testosterone (T) were measured, and the testosterone to cortisol ratio (T:C) was calculated. Samples were taken at baseline, following CWI, following ECP therapy and the morning following the intervention, and analysed by immunoassay. Symptoms of stress were measured weekly using the Daily Analyses of Life Demands of Athletes (DALDA) questionnaire.
Results
After ECP there was a likely large decrease in C (37%, ES = 1.1,[-.2 to -3.1,90%CL]) and likely large increase in T:C (75%, ES = 1.1,[.3 to 1.9]). On day 2, there was a very likely large decrease in C (ES = 1.2,[-.5 to -2.0]) and likely moderate increase in T:C (ES =.8,[.3 to 1.9]) following the ECP condition. Following CWI, there was an almost certain large (ES = 1.9) and likely large (ES = .9) decrease in C and an almost certain large (ES = 1.4) and likely large (ES = .9) increase in T:C in the CWI and CWI plus ECP conditions respectively. Subjective symptoms of stress (DALDA) were significantly better following ECP, with fewer "worse than normal" responses in Part A ($P < 0.05$) and Part B ($P < 0.05$) and significantly more ($P < 0.05$) "better than normal" responses.
Discussion
The addition of ECP to a recovery protocol resulted in lower levels of C and a higher T:C ratio on the subsequent day reflecting improved recovery and a higher state of anabolism. These hormonal data were supported by improved perceptual symptoms of stress in elite athletes following ECP therapy. Therefore the addition of ECP therapy resulted in improved recovery following rugby league match play.
Reference
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Contact
v.kelly2@uq.edu.au

RESTING TO RECOVER: INFLUENCE OF SLEEP EXTENSION ON RECOVERY FOLLOWING HIGH-INTENSITY EXERCISE.

PITCHFORD, N.W., BISHOP, D.J.. BARTLETT, J.D.

VICTORIA UNIVERSITY

Introduction
Despite the importance of sleep for recovery (Halson, 2014), athletes fail to meet current sleep recommendations (Lastella et al., 2014). This issue may be accentuated by sleeping in unfamiliar environments (Pitchford et al., 2017), during periods of high cumulative training loads (Pitchford et al., Unpublished) and by restrictive training schedules (Kölling et al., 2016). Our lab has data indicating that athletes obtain increased sleep when given the opportunity (Pitchford et al., Unpublished), yet the influences of increased sleep on post-exercise recovery are unknown. This study examined the influence of sleep extension by way of increased overnight sleep opportunities and daytime napping on physiological and psychometric measures of recovery following high-intensity intermittent running exercise (HIIE).
Methods
In a randomised repeated measures design, participants completed three trials. Following a bout of HIIE participants slept in laboratory conditions for 1 night of restricted sleep (6h in bed) followed by 3 intervention nights of 8h time in bed (CON), 10h time in bed (EXT) and 8h time in bed plus a 2h nap each afternoon (NAP). Participants were assessed for peak isometric knee extensor torque production (PkTq), sprint time (5m, 10m and 20m splits), endurance (YoYo IR1) performance, subjective recovery and profile of mood states (POMS) at Pre, 0h, 1h, 2h, 12h, 36h, 60h and 84h post-HIIE. Wrist-watch actigraphy measured total sleep time (TST), sleep efficiency (SE) and wake after sleep onset (WASO). Multiple multi-level linear mixed models and Least Squares mean tests identified whether standardised differences (<0.20 trivial, 0.21–0.60 small, 0.61–1.20 moderate, 1.21–2.0 large and >2.1 very large) were larger than the smallest worthwhile change.
Results
TST was very likely largely increased for both NAP and EXT compared to CON. However, this was accompanied by likely small to very likely moderate increases in WASO from 36h to 84h post-HIIE. Whilst all groups displayed a likely small reduction in PkTq production post-HIIE, NAP had a likely small positive effect on PkTq at +36 h compared to CON. Sprint times recovered fully in EXT and NAP, such that EXT displayed very likely largely and NAP likely moderately faster 5 m, very likely largely and likely moderately faster 10 m, respectively, and very likely largely and likely moderately faster 20 m splits, respectively, compared to CON. Both NAP and EXT caused a likely small increase in stress compared to CON.
Discussion
These data show that when presented with the opportunity, sleep time can successfully be increased, which may positively influence the recovery of muscle function, sprint performance and stress. These factors are crucial components of recovery and if not restored, can have negative influences on athletic performance. Increasing total sleep time following exercise may be of benefit to athletes involved in tournament-like competition and/or multiple games in a week, where the emphasis is on recovery.

Oral presentations

OP-PM26 Sports technology: Game sports

EVALUATION OF LATEST GPS AND LPS FOR DETERMINING MOVEMENT PATTERNS IN SOCCER

HOPPE, M., BAUMGART, C., POLGLAZE, T., FREIWALD, J.
DEPARTEMENT OF MOVEMENT SCIENCE, UNIVERSITY OF WUPPERTAL, GERMANY

Introduction
In soccer, global (GPS) and more recently also local positioning system (LPS) have become standard tools for monitoring movement patterns during matches and training sessions (Buchheit el al., 2014). While it is accepted that 10 Hz GPS is most appropiate, it is presently unclear if higher GPS sampling rates or the newer LPS further increase the validity and reliability for measuring soccer sepcific movements (Scott et al., 2016). Thus, our study aimed to evaluate established 10 Hz GPS and latest commercial available 18.18 Hz GPS and 20 Hz LPS for determining movement patterns in soccer.
Methods
Six male recreational athletes performed outdoors 10 trails of a soccer specific circuit that was equipped with double-light timing gates. During the circuit, the athletes wore two of the following devices: (a) 10 Hz GPS (MinimaxX S4, Catapult Innovations), (b) 18.18 Hz GPS (GPEXE PRO, EXELIO srl) and (c) 20 Hz LPS (KINEXON precision technologies). From the measured and filtered velocity data, distances covered and sprint mechanical properties (e.g. maximal horizontal velocity, force and power) were computed. Sprint mechanical properties were modeled via a new inverse dynamic approach applied to the center of mass (Samozino et al., 2016). Validity was determined by comparing the measured and „true" values via the typical error of estimate (TEE), while reliability was examined by comparing the two devices of each system via the coefficient of variation (CV).
Results
The 18.18 Hz GPS had better validity and reliability for determining distances covered (TEE: 1.6-8.0%; CV: 1.1-5.1%) and sprint mechanical properties (TEE: 4.4-14.3%; CV: 3.1-7.5%) than the 10 Hz GPS (TEE: 3.0-12.9%; CV: 2.5-13.0% and TEE: 4.1-23.1%; CV: 3.3-20.0%). However, of all evaluated systems, the 20 Hz LPS showed the best validity and reliability overall (TEE: 1.0-6.0%; CV: 0.7-5.0% and TEE: 2.1-9.2%; CV: 1.6-7.3%).
Discussion
Sampling rates above 10 Hz further improve validity and reliability of GPS for determining movement patterns in soccer. However, the newer LPS had superior validity and reliability than both GPS. Since performance differences (e.g. between or within teams) and training effects (e.g. according to the pre-season) are generally small in soccer, especially on a top-level, it is recommended to use for practical meaningful decisions the most valid and reliable system, namely here, the 20 Hz LPS.
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Contact
m.hoppe@uni-wuppertal.de

HIGH-ACCURACY UWB & MEMS-BASED INDOOR LOCALIZATION SYSTEM FOR INDOOR SPORTS ACTIVITIES

LIU, Y., CHEN, Q., JIANG, S., XIAO, S.
CHINA INSTITUTE OF SPORT SCIENCE; INSTITUTE OF TELECOMMUNICATION SATELLITE, CHINA ACADEMY OF SPACE TECHNOLOGY

Introduction
Global Positioning System has been constructed and practically used for wide variety of sports. Nevertheless, GPS cannot receive acceptable positioning result in the indoor environments because of multipath effect. Indoor localization technology has become an effective way for indoor Sports Activities. The conventional indoor localization technology such as WI-FI, Bluetooth, with positioning accuracy reaching to meter grade, would no longer be sufficient for the indoor competition and training. Therefore, the aim of this study was to design an UWB & MEMS-based indoor localization system to obtain high accuracy in indoor sport events.
Methods
The proposed indoor localization system is designed basing on a chip UWB (Ultra Wide Band) transceiver as the estimate output of the true position, and a low cost Wearable MEMS-IMU (Micro Electro Mechanical System-Inertial Measurement Unit) sensor used for movement tracking. The high accuracy of the indoor localization is achieved by combining the mentioned two part. The effectiveness of the indoor localization system is demonstrated through the algorithm simulation analysis based on the software of Matlab. The performance analysis is tested in the large indoor venues (indoor track) and the small-sized room (office 7m×3m).
Results
The software simulation results show that the proposed UWB & MEMS-based indoor localization system can effectively improve the accuracy of indoor location reaching to centimeter grade. The Venue test results show that the performance of localization accuracy in the large indoor venues is better than the small-sized room.
Discussion
The effectiveness of the proposed indoor localization system is demonstrated through the results. The reason that localization accuracy in the small-sized room was more precise, is the channel characteristics of the small-sized room are more complex, including energy attenuation, multipath propagation and so on. Due to the feature of high speed in the sport event, future research should investigate the real-time performance in the indoor localization application.
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Contact

liuyongqing@ciss.cn

GPS VARIABLES CLASSIFICATION PROPOSAL BASED ON RATIONAL QUALITATIVE FEATURES

GOMEZ, A.1, FERNANDEZ, J.1, MEDINA, D.1, CASAMICHANA, D.2

1. FC BARCELONA. 2. UNIVERSIDAD EUROPEA DEL ATLANTICO

Introduction
One of the main issues interpreting GPS data is the huge amount of variables and the lack of a rational classification of the relationship among them. We propose three groups to categorize these variables: locomotor, mechanical and metabolic. Correlation between variables is presented to support the choice of these categories.
Methods
34 matches among 27 different professional football players of Barça B were evaluated (n= 457 records; 16.93 ± 7.74 records per player). The head physical coach selected the 14 variables most commonly used during weekly analysis. The first category, `locomotor variables (LOC)', groups those variables calculated solely through the GPS measurements, related with travelled distance and speed: distance travelled (DIS), number of sprints (SPR), max speed (MAX), high speed running (HSR), accelerations (ACC) and decelerations (DEC). The second category, `mechanical variables (MEC)', included variables related with intensity and impacts: dynamic stress load (DSL), total loading (TLO), lower speed loading (LSL), and fatigue index (FAI). The third category, `metabolic variables (MET)' groups those associated with energy expenditure and exertion as result of vendor-specific calculations: average metabolic power (AMP), relative average metabolic power (PER), high metabolic load distance (HMLD) and high metabolic efforts (HME). For each variable, three multiple linear regression were fitted using as predictors the variables belonging to each proposed group, to assess the degree of variance explained by each group through adjusted r-squared metric.
Results
MEC variables variance was significantly better explained by the MEC group: DSL (LOC: r=0.23; MEC: r=0.96; MET: r=0.28), TLO (LOC: r=0.44; MEC: r=0.85; MET: r=0.48), LSL (LOC: r=0.071; MEC: r=0.55; MET: r=-0.02), FAI (LOC: r=0.08; MEC: r=0.95; MET: r=0.14). For LOC variables the results were: SPR (LOC: r=0.8; MEC: r=0.04; MET: r=0.46), MAX (LOC: r=0.22; MEC: r=0.025; MET: r=0.06), ACC (LOC: r=0.56; MEC: r=0.36; MET: r=0.56), DEC (LOC: r=0.69; MEC: r=0.37; MET: r=0.68), and DIS (LOC: r=0.39; MEC: r=0.91; MET: r=0.99). For MET variables a similar amount of explained variance is observed by MET and LOC groups: AMP (LOC: r=0.66; MEC: r=0.38; MET: r=0.78), PER (LOC: r=0.64; MEC: r=0.47; MET: r=0.77), HML (LOC: r=0.74; MEC: r=0.46; MET: r=0.66), HEF (LOC: r=0.83; MEC: r=0.74; MET: r=0.87).
Discussion
A qualitative classification of GPS variables in three groups was provided. Based on the results obtained, the amount of variables in each group could be considerably reduced. This simplification would improve significantly the analysis process by physical coaches.
Contact
antonio.gomez@fcbarcelona.cat

RUNNING AND METABOLIC DEMANDS OF ELITE RUGBY UNION ASSESSED USING TRADITIONAL, METABOLIC POWER AND HEART RATE MONITORING

DUBOIS, R., PAILLARD, T., LYONS, M., MAURELLI, O., PRIOUX, J.

LAPPS AND M2S

Introduction
Commonly, studies which analyzed the time motion in rugby union (RU) are interested in the running demands only from studying the running speed. However, running activity of RU requires numerous accelerations, which are too often neglected (Owen et al., 2015). Indeed, these efforts contribute to increase the metabolic energy expenditure of the running. Therefore, the metabolic power approach (di Prampero et al., 2005) represent an interesting alternative in considering the accelerations and the speed to calculated the energy cost of the running activity. Furthermore, the HR-based method remains rarely used during official games, while it could better quantify the game metabolic demands. The aims of this study were to i) analyze the elite RU game demands through 3 different quantification methods, ii) and compare the methods.
Methods
14 professional players (7 Forwards (F) and 7 Backs (B)) over 5 professional games were equipped by GPS technology (GPSport) and HR monitor (Polar T34). Mixed linear model allows to analysis the game demands through 3 different methods, depending on the playing positional groups and different intensity zones in the 3 approaches. Thresholds of 14.4 km.h-1, 20 W.kg-1 and 85% of HRmax were set respectively for high-speed running (HSR), high metabolic power (HMP) and high HR exertion (HHRE).
Results
The mean % of HRmax was 80.6 ± 4.3% during a typical match, and the % of the time spent above HHRE threshold of a game was 42.2 ± 16.5%. F spent more time than B in 85-92% HRmax ($p < 0.05$). B covered a greater distance than F in HSR (+35.2 ± 6.6%; $p < 0.01$; ES: 1.0). However no significant difference was found between F and B concerning the HMP distance. The % difference between HSR and HMP distances was 38.1% with significant difference ($p<0.001$) between F (52.7%) and B (24.8%). Nearly perfect correlations were found between the traditional and metabolic approaches ($r = 0.93$; $p<0.001$ between HSR and HMP distances). Equivalent distance covered showed the highest correlation with the HRE ($r=0.59$, $p<0.001$).
Discussion
The difference in absolute values and the great correlation between the HSR and HMP distances efforts proves that the metabolic power approach may constitute an interesting alternative to the traditional approach to evaluate the high-intensity running efforts in RU. Finally, the HR monitoring also provide interesting information about the metabolic demands during professional RU games, which can help coaching staff in the design of training drills and optimize training programs.

QUANTITATIVE ASSESSMENT OF OFF-THE-BALL MOVEMENTS BASED ON QUALITATIVE ASSESSMENT IN INVASION GAMES

FUCHITA, K.1, TAZUKE, S.1, GOUDA, N.2, TANAKA, T.3

1: DOSHISHA UNIVERSITY, 2,3: HITACHI, LTD

Introduction

Due to game-based approaches being brought forward in literature, measurement procedures and instruments that can appropriately assess off-the-ball movements were considered and reported. However, these studies were all conducted under the qualitative assessment of a ball game expert and no study has been done to evaluate off-the-ball movements quantitatively. Therefore, the present study focused on the movement of the player receiving the pass in invasive games and aimed to evaluate offensive off-the-ball movements quantitatively based on qualitative assessment.
Methods
Games were referred from game-test situations "Off-the-ball movement"(cf. Memmert and Roth, 2007). Forty-one children(ages, 11.7 ± 1.40 years; 21boys and 20girls) participated and total of 30games were played. Team members and opponents were randomized each time. Games were recorded on videotape. All participants wore a Three-Axis Acceleration Bracelet and quantitative data was collected while playing the game. Transfer entropy between players were calculated from data of the three-axis acceleration and information transmission was estimated between players. Further, we networked information transmission of the group. From the videos recorded, three ball game experts assessed the players' offensive off-the-ball movements which focused on space and timing when receiving a pass with a scale of 1-3(1: Good, 2: Average, 3: Poor). Movements that were assessed as "Good" by two or more experts were classified as good group (53plays), poor group (5plays) were classified in the same way, and the other movements were classified as average group (122plays). Since there were only 5plays in the poor group, good group and average group were analyzed. Two groups' data of transmission information were compared.
Results
The number of paths of information transmission from teammates to good group players was significantly greater than the average group ($p<.05$). On the other hand, the number of paths of information transmission from opponents to good group players was significantly less than the average group ($p<.05$).
Discussion
It is quantitatively shown that players who were assessed as moving into the good places with good timing by experts, react to teammates' movements and other players react to opponents' movements.
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METABOLIC POWER: A SENSITIVE TOOL TO DETECT REPEATED HIGH INTENSITY EFFORTS IN TEAM SPORT

POLGLAZE, T.1, DAWSON, B.1, BUTTFIELD, A.2, PEELING, P.1,3

1: UNIVERSITY OF WESTERN AUSTRALIA (PERTH, AUSTRALIA), 2: BIOALCHEMY (ADELAIDE, AUSTRALIA), 3: WESTERN AUSTRALIAN INSTITUTE OF SPORT (PERTH, AUSTRALIA)

Introduction
Whilst the physiological demands of repeated high intensity efforts (RHIE) are understood (Spencer et al, 2005), recent analysis suggests RHIE bouts seldom occur in elite team sport (Schimpchen et al. 2016). However, high intensity (HI) was classified solely according to speed, with acceleration overlooked. The interaction between speed and acceleration via metabolic power (PMet) provides a more complete estimate of energy cost for variable-speed running (Osgnach et al. 2010). Hence, this study aimed to determine whether PMet is a more sensitive tool for the detection of RHIE bouts in team sport activity.
Methods
Male hockey players (n=16) wore 10 Hz GPS devices in 6 international matches. HI efforts (min 1 s) were defined via speed (5.5 m.s-1), acceleration (1.5 m.s-2), and PMet (25.5 W.kg-1) thresholds. RHIE bouts were defined as 3 or more HI efforts with a mean recovery time of 20 s or less. RHIE was classified using HI efforts defined by speed only (Sp), speed or acceleration (SpAc), or PMet. The number of RHIE bouts, number of efforts per bout, and mean effort and recovery time, were compared for each classification method.
Results
The number of RHIE bouts per player per match was higher for PMet (7.3±2.8) than Sp (0.4±0.6 $p<0.00$) and SpAc (2.8±1.7 $p<0.00$). There were more efforts per bout (PMet 3.6±0.4, Sp 3.2±0.4 $p<0.00$, SpAc 3.4±0.4 $p<0.00$), but effort duration was shorter (PMet 1.9±0.3 s, Sp 2.6±1.2 s $p<0.00$, SpAc 2.1±0.6 s $p=0.01$). Recovery time was similar (PMet 8.3±1.8 s, Sp 9.1±3.9 s, SpAc 8.8±2.8 s).
Discussion
RHIE is a physiological construct based on the ability to replenish ATP between brief HI efforts (Spencer et al. 2004), hence should be defined by metabolic rather than neuromuscular parameters. When it is assumed that speed is a direct indicator of intensity, a large amount of HI work is undetected and, seemingly, RHIE seldom occurs in international hockey. If acceleration is also considered, more RHIE is identified. However, because maximal acceleration is dependent on initial speed (Sonderegger et al. 2016), absolute thresholds only detect efforts occurring at low speed, and some HI work remains undetected. The interaction of speed and acceleration (via PMet) provides a more sensitive tool for the detection of RHIE in team sport activity, demonstrating that RHIE bouts occur frequently in international hockey.
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Contact
ted.polglaze@research.uwa.edu.au

Oral presentations

OP-BN12 Balance and posture

THE EFFECT OF ISOLATED CORE STABILITY TRAINING ON UPPER EXTREMITY PERFORMANCE IN OVERHEAD ATHLETES

BASANDAC, G., TUNAY, V.B., HARPUT, G.

ACADEMY SPORTS HEALTH & PERFORMANCE CENTER, İSTANBUL-TURKEY, HACETTEPE UNIVERSITY, FACULTY OF HEALTH SCIENCES DEPT. OF PHYSICAL THERAPY AND REHAB, ANKARA

Introduction
There is limited knowledge explaining the effect of isolated core stability training on upper extremity performance in overhead athletes. The aim of this study was to investigate the effects of progressive isolated core stability training on shoulder internal and external rotator strength, and upper extremity functional performance such as push up, upper extremity closed kinetic chain and medicine ball throw tasks in female adolescent volleyball players.
Methods
Randomized controlled trial. Forty two adolescent female volleyball athletes (age: 16.0±1.4 years) were randomly divided into two groups. Group 1 participated into 8-week progressive isolated core stability training program while Group 2 was not received any special core stability training. Shoulder internal (IR) and external rotator (ER) strength, medicine ball throw (MBT), modified push up (MPU) and upper extremity closed kinetic chain (UE_CKC) tests were used to evaluate physical performance. Repeated measures of ANOVA was used for statistical analysis.
Results
Time by group interaction was found significant for UE_CKCT ($F(1,40)=24.61$, $p<0.001$), MPUT ($F(1,40)=12.23$, $p=0.001$) and MBT ($F(1,40)=138.69$, $p<0.001$). Compared to Group 2, Group 1 showed better scores in UE_CKC ($p<0.001$), MPU ($p=0.04$) and MBT ($p<0.001$) tests after training. However, there was no time by group interaction for IR ($F(1, 40)=0.31$, $p=0.58$) and ER ($F(1,40)=2.01$, $p=0.16$) strength.
Discussion
This study showed that eight-week progressive isolated core stability training program enhanced the upper extremity physical performance without increasing the shoulder rotator strength in adolescent female volleyball athletes. Therefore, core stability training programs should be incorporated with sport specific training programs to better enhance the athletic performance.

SENSORY INTEGRATION OF LIGHT TOUCH CUES IN HUMAN STANDING BALANCE

ASSLÄNDER, L.1, SMITH, C.2, ALLSOP, J.3, GRUBER, M.1, REYNOLDS, R.2

1) UNIVERSITÄT KONSTANZ, 2) UNIVERSITY OF BIRMINGHAM, 3) ANGLIA RUSKIN UNIVERSITY

Introduction
Sensory information from touching a space stationary reference point reduces spontaneous sway in human standing balance (Holden et al. 1994). In addition, body sway responses can be evoked by moving the space reference, where the sway responses show a non-linear pattern (Oie et al. 2001). Integrating sensory cues from a light touch reference requires a comparison to other sensory signals. During eyes closed, these other signals encode angular cues (neglecting translational acceleration due to the bad signal quality). Therefore, we hypothesized that light touch cues are transformed to angular cues in the integration process.
Methods
Sway responses to a touch-pad moving on a circular arc around the ankle joints were measured in 8 subjects (27 +/- 3 yrs, 4 male). The touch-pad movement followed a pseudo-randomized stimulus sequence, applied at three angular amplitudes, and at two radii of 0.8 and 1.2 m. Stimuli were designed, such that three pairs of stimuli were identical in terms of angular motion, but differed in terms of absolute motion due to the different radius. Hip and shoulder sway was measured and whole body centre of mass movement was calculated thereof. 13 consecutive repetitions of the stimulus cycle were measured and averaged across cycles to provide an estimate of the sway response to the stimulus.
Results
Sway responses differed significantly between the two radii for all stimulus amplitudes. However, plotting sway response amplitudes with respect to horizontal stimulus amplitudes - as opposed to the angular stimulus amplitude – revealed a consistent change of sway responses with respect to changing stimulus amplitudes for all six conditions. Sway responses showed a non-linear pattern, where the ratio of stimulus and sway response decreased with increasing stimulus amplitude.
Discussion
Our results reject the hypothesis that light touch cues are referenced to angular motion around the ankle-joints. Rather, the touch reference seems to be integrated in terms of absolute horizontal movement. To this end, a subjective horizontal (or vertical) is required as a reference frame for the integration of the light touch cues. The non-linear sway responses pattern was reminiscent to that dedicated to sensory reweighting during surface and visual scene tilt stimuli (Peterka 2002).
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Contact
lorenz.asslaender@uni.kn

RELATIONS BETWEEN BALANCE ABILITY AND POSTURAL SWAY IN VISUAL DEPRIVED MONOPEDAL STANCE

FISCHER, H., BENEKE, R.

PHILIPPS UNIVERSITY MARBURG - GERMANY

Introduction
Large postural sway is frequently discussed as an indicator of poor balance ability (Yoon et al., 2012). However, postural sway may also provide (additional) sensory information essential for balance regulation. A given amount of postural sway variability would give may

reflect a required level of sensory stimulation (Clark and Riley, 2007). Purpose of this study was to investigate relations between balance ability and postural sway in a visual deprived monopedal stance.
Methods
43 healthy participants (27 males, 16 females; 25.6 ± 3.6 yrs; 176 ± 8 cm; 73 ± 12 kg) stood six times on one leg, preferred and unfavoured leg in randomised order, with eyes closed as long as possible. During a one minute break between each stance they sat down. Standing time was recorded. Postural sway in terms of velocity, 95% ellipse area and displacement along medio-lateral and anterior axis of Center of Pressure (CoP) were measured by a force plate in subsequent periods lasting 30 s each. Coefficients of variability of displacement in medio-lateral and anterior-posterior axis were calculated. Interrelations between standing time and CoP variables of first and last 30 s observation period of the longest stance out of six and corresponding differences of CoP variables between first and last 30 s period were analysed.
Results
Standing time (218.4 ± 201.1 s) correlated negative with CoP-area of the first 30 s period (23.6 ± 10.7 qcm) ($r = -0.363$; $p \leq 0.05$). In participants, who completed at least two or more 30 s observation periods (N = 29) CoP-area increased from first (21.0 ± 9.9 qcm) to last 30s period (25.9 ±10.8 qcm; $p \leq 0.05$), but there were no interrelations between standing time and CoP variables.
Conclusion
Balance ability in visual deprived monopedal stance negatively related to the area of postural sway during the initial 30s of standing. This is in line with the thesis that a larger postural sway indicates poor balance ability. No such effect can be seen shortly before balance becomes limited.
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A MATERNITY SUPPORT BELT AFFECTS POSTURE BUT NOT STATIC STABILITY IN PREGNANT WOMEN

BEY, M.E., ARAMPATZIS, A., LEGERLOTZ, K.
HUMBOLDT-UNIVERSITAET ZU BERLIN

Introduction
Pregnancy leads to numerous physical and hormonal changes. Some of these changes may contribute to an increased risk to fall, as it has been reported that 27% of pregnant women experienced a fall (Dunning et al., 2003). A maternity support belt (MSB), which is similar to a flexible, elastic kidney belt, is assumed to stabilize the pelvis and to enhance balance ability in pregnant women (Cakmak et al., 2014). The purpose of this study was to investigate the effect of a MSB on stability. We hypothesized that deteriorations in static stability and postural sway can be reduced using a MSB.
Methods
Ninety healthy pregnant women (30 ± 4 years) in different trimesters of pregnancy (T1: 1-13, T2:14-26, T3: 27-40 week of pregnancy) and thirty healthy non-pregnant controls (28 ± 6 years) were recruited. Balance assessment was performed in static conditions determining the anterior and posterior limits of stability (LoS) with and without a MSB. Postural sway during quiet standing was estimated analyzing the path length, velocity, maximum amplitude (medio-lateral, anterior-posterior) and the 95 % confidence ellipse. In addition a survey about the frequency of falls and physical activity during pregnancy was conducted.
Results
Body mass continuously increased during pregnancy, being significantly higher in T2 and T3 compared to the controls, while the difference to T1 was not yet significant (Delta=4,7±2,6 kg). The LoS increased in T1 (anterior: 6,1 cm; posterior: 5,0 cm) and T3 (anterior: 6,3 cm; posterior: 5,0 cm) compared to the controls (anterior: 5,0 cm; posterior: 4,3 cm). The MSB did not affect LoS. However, it led to a significant posterior shift of the center of mass during quiet standing, both in pregnant and non-pregnant women (DeltaT1=1,6 %, DeltaT2= 2,3 %, DeltaT3=0,9 %; DeltaC=0,7 % foot length).
Discussion
Static stability in pregnant women is reduced compared to non-pregnant women, already in the first 13 weeks of pregnancy. Since body mass in T1 is slightly and not significantly higher compared to the controls, other factors e.g. hormone associated changes of the musculoskeletal system are likely to have a more pronounced influence on LoS. While a MSB does not influence static stability it affects body posture by shifting the center of mass to posterior. This change might be caused by the limited pelvic mobility, an increased focus on the pelvis and/or changes in proprioception. The effect on body posture may be associated to the assumed effect in reducing back pain using a MSB (Carr, 2003).
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DYNAMIC POSTURAL STABILITY ASSESSMENT: DO DIFFERENT TESTS MEASURE THE SAME?

RINGHOF, S., HANSERT, M., HIEMER, V., STEIN, T.
KARLSRUHE INSTITUTE OF TECHNOLOGY (KIT)

Introduction
Postural control traditionally has been treated as a general ability. Recent research, however, suggests that the principle of task-specify also applies to postural control, whereat the nervous system uses different mechanism to control balance (Giboin et al. 2015). Whether the existing experimental approaches to estimate dynamic stability actually measure similar or different postural skills, therefore, remains questionable. The purpose of the present study was to employ athletes with different expertise in balance (gymnasts vs. swimmers) and by this means to investigate associations of dynamic stability using three frequently applied test procedures.
Methods
Participants were 24 healthy young females (age: 23.7 yrs), who were training regularly either in gymnastics (n=12) or swimming (n=12). In counterbalanced order, subjects were asked to perform three dynamic stability tests: jump-landing from one-leg jumps (OLJ), balance recovery after simulated forward falls, and multidirectional perturbations of an unstable platform (Posturomed). In each of the tests, subjects were instructed to recover balance as quickly as possible, which was computed by use of the time to stabilization (TTS) deduced

from AMTI forces plates and Vicon motion capturing, respectively (McKinley & Pedotti, 1992). Besides, CoP displacements during 30 sec single-leg stance were recorded to assess correlations between static and dynamic stability.
Results
Pearson's correlations revealed that relations between the different tests of dynamic stability were not statistically significant (r=0.03–0.32). Merely within Posturomed trials, TTS correlated significantly between some directions of perturbation (r=0.49–0.59). Considering correlations between static and dynamic stability, as expected no significant relations were found. Moreover, independent t-test indicated that in OLJ gymnasts recovered balance significantly faster compared to swimmers (p=0.008).
Discussion
The study has shown that the dynamic stability tests compared here did not find any associated results when conducting TTS as stability measure, indicating that the different tests seem to measure different postural capabilities. In fact, only OLJ were able to distinguish between both groups of athletes. Gymnasts might gain an advantage here from incorporating balance and jump-landing exercises regularly into practice. In conclusion, this study supports recent findings assuming postural stability to be classified as a highly task-specific sensorimotor skill (Giboin et al., 2015). Bearing this in mind, literature must always viewed with caution when generalizing effects of different balance tests. Further, it is emphasized that testing methods should be selected depending on the specific aims or interventions of a study.
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Contact
steffen.ringhof@kit.edu

INVESTIGATION OF THE USE OF THE ARMS IN RECOVERING FROM POSTURAL PERTURBATIONS

AK, E., ERDOGAN, A., KORKUSUZ, F., KOCAK, S., PIAZZA, S.
GLORIA SPORTS ARENA

Introduction
Despite extensive preventive efforts, falls continue to be a major source of morbidity and mortality Understanding the methods used to recover from falling is important to develop necessary prevention techniques. Arm movements play an important role in recovering from postural perturbations.
Method
This study aimed to understand the effects of arm rotations in three different levels of perturbation. The participants leaned forward in 5.5, 6.5 and 7.5 degrees and suddenly released by switching off the electromagnet attached on their back. A six camera motion analysis system and a force plate were used to record the kinetic and kinematic variables. Visual 3d software was used to create subject specific models. The angular momentum of the arms about the shoulder and MTP joints were calculated. The differences between 5.5 and 6.5 degrees were compared in terms of the angular momentum and the angular velocity of the arms. None of the participants were able to recover from 7.5 degrees.
Results
Significant differences were found between 5.5 and 6.5 degrees in peak negative angular momentum of the arms, and negative and positive angular velocity of the forearms. There was no significant difference between the ground reaction forces, steady state times and shoulder torques. The relationships between angular velocity of the arms and Body Mass, Stature, Moments of Inertia of the forearms and BMI were found to be significant for 6.5 degrees.
Conclusion
In conclusion, it can be speculated that central nervous system does some very complicated calculation based on the person's physical characteristics to create necessary kinetic and kinematic effects to recover from falling.

Oral presentations

OP-PM58 Training and exercise in clinical populations 1

MELATONIN DECREASES DIABETES MUSCULAR INFLAMMATION INDUCED BY STRENUOUS EXERCISE

HATANAKA, E.
CRUZEIRO DO SUL UNIVERSITY

Introduction
Strenuous physical exercise can potentially induce skeletal muscle injury and inflammatory responses related to increased free radical generation. The combined increment in the oxidative stress and cytokine production in diabetic subjects following an intense exercise session elevates the inflammatory response, contributing to the onset of diabetic complications [1]. Additionally, resting time for diabetic individuals undergoing strenuous exercise must differ from that from non-diabetic control subjects [2]. Melatonin, a classic antioxidant, has been shown to exhibit beneficial effects regarding diabetes and tissue repair [3]. In this study, we evaluated the onset and resolution of inflammation in control and melatonin-treated diabetic rats subjected to a strenuous exercise session.
Methods
Diabetic control and diabetic melatonin-treated rats were subjected to exhaustive exercise after a period of 10 days of melatonin treatment (20 mg/dL). Plasma and muscle levels of tumor necrosis factor-alpha (TNF-α), interleukin-1 beta (IL-1β), interleukin-6 (IL-6), cytokine-induced neutrophil chemoattractant-2-alpha/beta (CINC-2α/β), l-selectin, macrophage inflammatory protein-3-alpha (MIP-3α), and vascular endothelial growth factor (VEGF) were measured before, immediately after, 2, 24, 48, and 72 h after exercise.
Results
Our data revealed decrease in the plasma concentration of IL-6 (73%), IL-1 β (87%), L-selectin (34%), and TNF-α (12%) in the melatonin-treated group. We also observed decreased muscle concentrations of IL-6 (42%), MIP-3 α (37%), L-selectin (72%), and VEGF (30%) in the melatonin-treated group compared with the control group.
Discussion

Muscle inflammation and oxidative stress resulting from exhaustive exercise were less severe in the muscles from melatonin-treated diabetic rats than that from control animals. We concluded that melatonin administration might help to regulate redox status and inflammation in diabetic rats aftler a strenuous physical exercise session.

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Contact
ehata@usp.br

IMPROVEMENTS IN FITNESS ARE NOT OBLIGATORY FOR EXERCISE TRAINING-INDUCED IMPROVEMENTS IN CV RISK FACTORS

HARTMAN, Y., HOPMAN, M., SCHREUDER, T., VERHEGGEN, R., SCHOLTEN, R., OUDEGEEST-SANDER, M., POELKENS, M., MAIORANA, A., NAYLOR, L., WILLEMS, P., TACK, C., THIJSSEN, D., GREEN, D.

RADBOUD UNIVERSITY MEDICAL CENTER, NIJMEGEN, THE NETHERLANDS; CURTIN UNIVERSITY, PERTH, AUSTRALIA; UNIVERSITY OF WESTERN AUSTRALIA, CRAWLEY, AUSTRALIA; LIVERPOOL JOHN MOORES UNIVERSITY, UK

Introduction
Cardiovascular benefits of exercise training are often ascribed to changes in levels of physical fitness and individual risk factors. The purpose of this study was to assess whether changes in physical fitness relate to changes in cardiovascular risk factors following standardised, centre-based and supervised exercise training programs in subjects with increased cardiovascular risk.
Methods
We pooled data from exercise training studies of subjects with increased cardiovascular risk (n=166) who underwent 8-52 weeks endurance training. We evaluated fitness (i.e. peak oxygen uptake) and traditional cardiovascular risk factors (BMI, mean arterial pressure (MAP), total cholesterol (TC), high density lipoprotein cholesterol (HDL)), before and after training. We divided subjects into quartiles based on changes in fitness, and examined if groups differed based on risk factors. Associations between changes in fitness and in cardiovascular risk factors were further tested using correlation analysis.
Results
Significant heterogeneity was apparent in the change in fitness and individual risk factors, with non-responder rates of 17% for fitness, 44% for BMI, 33% for MAP, 49% for total TC and 49% for HDL. Neither the number nor the magnitude of changes in cardiovascular risk factors differed significantly between quartiles. Furthermore, changes in fitness were not correlated with changes in cardiovascular risk factors (all $p>0.05$).
Discussion
Our data suggest that significant heterogeneity exists in the effect of exercise training on peak oxygen uptake, the magnitude of change in CV risk factors, as well as the number of CV risk factors that improved after training. We found that improvements in fitness were not obligatory for training-induced improvements in CV risk factors. Together these findings imply that fitness gain may not directly drive improvement in CV risk factors and, vice versa, that exercise training can improve CV risk factors, even in the absence of changes in fitness.

Contact
Yvonne.hartman@radboudumc.nl

THE USE OF THE CR-10 SCALE TO ALLOW SELF-REGULATION OF ISOMETRIC EXERCISE INTENSITY IN PRE-HYPERTENSIVE AND HYPERTENSIVE PARTICIPANTS.

MORRIN, N.1, STONE, M.1, SWAINE, I.2, HENDERSON, K.1

1: BUCKINGHAMSHIRE NEW UNIVERSITY, 2: UNIVERSITY OF GREENWICH

Introduction
Isometric handgrip exercise (IHE) performed at 30% MVC has been shown to lower blood pressure (BP; Millar et al,. 2014). In addition, findings suggest that a systolic BP (SBP) change of >20mmHg is associated with larger BP reductions (Badrov et al,. 2013). Handgrip intensity is normally regulated using equipment with force output displays, however this equipment is expensive and intensities may not elicit an appropriate BP response. A simple, cost-effective and home-based alternative deserves investigation. The purpose of this study was to establish a relationship between markers of IHE intensity (%MVC, SBP change) and perceived exertion (CR-10 scale) and assess the validity of perception-based intensity regulation.
Methods
Fourteen pre-hypertensive and hypertensive adults completed eight, 2-minute IHE at randomised intensities; participants estimated their perceived exertion at 30-second intervals (estimation task). Subsequently, during four, 2-minute contractions, on three separate occasions (trial 1-3), participants were asked to produce an exertion level that they perceived to be equivalent to CR-10 "Level-6".
Results
There were significant linear relationships between the estimated exertion on the CR-10 scale, and SBP change ($r=0.784$) and %MVC ($r=0.800$). Level 6 was equivalent to an average SBP change of 38mmHg (95% CI; 44mmHg, 32mmHg) and a relative force of 33% MVC (95% CI; 36.2%, 30%). When "level-6" was prescribed in the production task, %MVC was not significantly different between the estimation task and all trials of the production task. However, in at least the first two repetitions of production trials 1-3, SBP change was significantly lower than the estimation task.
Discussion
Findings from the estimation task indicated that the CR-10 "level-6" would be the most appropriate level for prescription within the production task. The production task revealed that the use of CR-10 "level-6" to achieve and regulate a target %MVC is justified. As compared with the estimation trial, there was an under-production of SBP across each production trial. These findings suggest that SBP is not the primary cue upon which perceived exertion is assessed during a 2-minute IHE. However, CR-10 "Level-6" can be used to regulate IHE force, and may be useful in IHE prescription.

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Contact
Niamh.morrin@bucks.ac.uk

EVALUATION OF MUSCLE OXIDATIVE METABOLISM DURING EXERCISE IN PATIENTS WITH AMYOTROPHIC LATERAL SCLEROSIS

FERRI, A., TREMOLIZZO, L., CORNA, G., BONAZZI, R., MAGGIANI, A., FERRARESE, C., LANFRANCONI, F.
VICTORIA UNIVERSITY

Introduction
Amyotrophic Lateral Sclerosis (ALS) is a fatal, rapidly-progressive, neurodegenerative disease, characterised by motor neuron degeneration and progressive skeletal muscle weakness. In addition to the decrease in muscle strength, patients with ALS (pALS) also present a reduced exercise tolerance (Mezzani et al 2012). The physiological factors implicated in the latter are not fully understood. Therefore, the main aim of this study was to uncover if there are impairments in the oxygen transport and utilization chain (from lung to skeletal muscle), which could explain the exercise intolerance in pALS. Our secondary purpose was to assess if the clinical heterogeneity of pALS could be related to differences in their exercise tolerance.
Methods
Seventeen pALS were compared to 13 healthy controls (CTRL) at baseline (T0) and after 4 months (T1). Maximal oxygen uptake (VO2peak) and pattern of breathing (pulmonary ventilation, VE) were assessed by cardiopulmonary exercise testing (CPET), while vastus lateralis maximal capacity of O2 extraction was measured by near infrared spectroscopy (NIRS). The ALS functional rating scale revisited (ALSFRS-R) was administered to pALS by a neurologist at T0 and T1.
Results
pALS displayed a 44% lower VO2peak vs CTRL ($p<0.0001$), which was associated with a 43% decrease in peak skeletal muscle O2 extraction ($p<0.01$); these two variables were significantly correlated ($r2=0.64$, $p<0.0001$). Maximal VE (VEpeak) was also reduced by 46% in pALS with respect to CTRL ($p<0.0001$), and pALS presented an inefficient breathing pattern (increased respiratory frequency for the same VO2 with respect to CTRL) from the onset till the end of CPET. In addition, ALSFRS-R score and VO2peak were significantly correlated ($r2=0.74$; $p<0.01$), but only in bulbar patients.
Discussion
Our results show that impaired skeletal muscle O2 extraction is a major determinant of exercise intolerance in pALS. The clinical heterogeneity of pALS with a bulbar onset seems to be related to their exercise tolerance. The use of CPET in conjunction with NIRS, is a useful non-invasive methodology to detect early stages of oxidative deficiency in the skeletal muscles of pALS.
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Contact
alessandra.ferri@vu.edu.au

Invited symposia

IS-SH05 Doping prevention – The role of coaches

INVESTIGATING UK-BASED COACHES' ROLES IN THE QUEST FOR CLEAN SPORT

PATTERSON, L.
LEEDS BECKETT UNIVERSITY

Global anti-doping policy states that athlete support personnel (ASP), such as coaches, have a responsibility to comply with all anti-doping rules and use their influence on athlete values and behaviour to prevent drug use in sport. Yet, there is very little research regarding coaches' roles in anti-doping efforts and this limits our ability to provide coaches with appropriate, evidence-based anti-doping education or training. Therefore, this study investigated coaches' experiences and opinions of undertaking a role in preventing drug use in sport. Two-hundred and ninety-two UK-based coaches responded to an online survey. The average age of respondents (n=289) was 43.45 (±13.82) years (range 17-88 years) and individuals had on average 12.58 (±10.14) years coaching experience (n=288, range <1-40 years). The study highlights that not all coaches undertake an anti-doping role and fulfill their 'policy-ascribed' anti-doping responsibilities signalling a need to engage in further research with this key stakeholder group to develop a greater understanding of the individual and environmental factors that influence coaches' willingness to be actively involved in anti-doping efforts. Such research will not only enable targeted anti-doping education programmes for coaches, but also can inform future debate about the feasibility of current 'one size fits all' policy expectations of ASP. Findings from follow-up projects may be presented.

DOPING IN SPORT: AUSTRIAN COACHES' KNOWLEDGE, ATTITUDES, AND PREVENTIVE BEHAVIOUR

BLANK, C., LEICHTFRIED, V., FISCHER, F., MÜLLER, D., SCHOBERSBERGER, W.
UNIVERSITY FOR HEALTH SCIENCES, MEDICAL INFORMATICS AND TECHNOLOGY

Coaches and sport teachers are considered to have a strong influence on athletes' doping-related attitudes and behaviour. Yet, in Austria, no research on the anti-doping efforts of this group was available. Therefore, the current study aimed to establish the knowledge, attitudes and behaviours of Western-Austrian coaches and sport teachers in preventing drug use in sport. A questionnaire investigating (a) perceived knowledge, (b) actual knowledge, (c) attitudes, and (d) coach behavior, was disseminated to 135 sport teachers and coaches. Data showed that Western-Austrian coaches had anti-doping attitudes and generally show a good level of actual knowledge about doping substances, methods and side effects. However, coaches' preventive behavior scores quite low (48.7±20.8), and behavior was negatively associated with perceived knowledge of the topic. This indicates that despite objectively having sufficient knowledge coaches

might be hesitant in providing information to their athletes. Thus, prevention strategies should aim to increase coaches' perceived knowledge by continuing their training – since only those coaches who perceive themselves to be competent will actively address the topic, thereby helping athletes develop and modify their own set of anti-doping values. Findings from follow-up projects may also be presented.

THE NATURE OF COACHES' EFFICACY IN CONFRONTING DOPING ATHLETES

SULLIVAN, P.

BROCK UNIVERSITY

Coaches acknowledge that they have a role to play in 'anti-doping'. However, coaches also feel that doping prevention measures are ineffective, and that their role in the process is problematic and unclear. One factor that holds promise in clarifying this process is coaches' self-perceived competency in confronting doping athletes. A sample of 560 Canadian and American football coaches completed the Doping Confrontation Efficacy Scale (DCES) and a modified version of the Perceived Motivation Climate in Sport Questionnaire-2. The results showed that coaches DCES possessed strong psychometric properties (CFI=0.967; RMSEA=0.040) and that Task-involving climate positively predicted doping confrontation efficacy (β=0.43), while ego-involving climate was a negative predictor (β=-0.30). Subsequent work has focused on the athletes' perception of their coaches' doping confrontation efficacy. A sample of 121 university athletes completed a modified version of the DCES that was rephrased to measure athletes' confidence in their coaches' ability to have a successful confrontation. Participants also completed the Performance Enhancement Attitude Scale (PEAS). In a multiple linear regression model athletes' perception of their coaches' confidence in the intimacy of their relations was the sole significant predictor (β=-0.31). In sum, these results signal that coaches' efficacy in confronting doping athletes is a significant factor in anti-doping.

Oral presentations

OP-SH12 Factors influencing physical activity

ACTIVE YOUTH - PHYSICAL ACTIVITY AND MOBILITY OF ADOLESCENTS IN PUBLIC SPACES IN VIENNA

DIKETMUELLER, R.1, MAIRINGER, F.1, KOLB, M.1, BITTNER, I.2, DAMYANOVIC, D.2, SCHAUPPENLEHNER, T.2, BEISER, V.2, NIEGL, M.3

1: UNIVERSITY OF VIENNA (AUSTRIA), 2: UNIVERSITY OF NATURAL RESOURCES AND LIFE SCIENCES (VIENNA, AUSTRIA), 3: KOMOBILE (VIENNA, AUSTRIA)

Introduction
The project investigates possibilities and opportunities of mobile devices to assess active mobility and the spatial context where the young are physically active. To analyze the complex mobility and activity patterns of the young an interdisciplinary approach connects the perspectives of landscape and traffic planning, social sciences and sport sciences. For scientists as well as practitioners (urban planning, health promotion), the aim of ActivE Youth is to develop an applicable set of methods to analyze human-powered mobility and to stimulate active mobility of the young through geo-based gaming on mobile devices.
Methods
Before and after an intervention where different geo-based methods were experienced, mobility patterns of pupils (n=35, 15-17yrs) out of two public schools in central and suburban Vienna were recorded by accelerometer (Actigraph GT3X+) and the smartphone-app Moves. Additional data was acquired by an analogue activity dairy, an online questionnaire and feedback-workshops. The data were analysed statistically and by a multilayered triangulation.
Results
The findings show, that the youngsters of both environments were more physically active and more likely to meet the WHO-recommendation for physical activity on weekdays than at the weekend. On weekdays only few youngster were cycling, most of the pupils choose to walk as active mobility. More physically active pupils show more complex active mobility patterns within the city and use more different types of open spaces (streets, squares, parks) whereas inactive pupils mostly use streets for their active mobility and are only actively mobile for daily routines (e.g. way to school). According to data triangulation, the data of the app and accelerometer were combined and mapped within GIS maps, which visualize activity and mobility patterns of the youth. Finally three types of (in)active young were identified.
Discussion
The results indicate that geo-based games and mobile devices can contribute for higher activity and mobility levels of young people, especially girls in suburban Vienna benefit from a more mobility friendly environment. Based on the results of focus group discussions with the pupils a set of methods for educational and planning settings was developed to activate young people in urban spaces.
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Contact
rosa.diketmueller@univie.ac.at

STUDY ON THE INTERGENERATIONAL RELATIONSHIP OF FAMILY PHYSICAL EXERCISE IN CHINA

FUBAIHUI, W.

CHINA INSTITUTE OF SPORT SCIENCE

Introduction
Parents play a exemplary and vital role in cultivating sports attitude and forming physical exercise behavior of children in a family. Therefore, the aim of this study was to analyze the characteristics and intergenerational relationship of family physical exercise in China, using the National Physical Activity Investigation data in 2015.
Methods

We used the household matching method to match family variable of integration through marriage and the inter-generational relations. From four dimensions of sports environment, economic capital, sports atmosphere and the degree of closeness among family members, we used logistic regression model to analyze the influencing factors and intergenerational relationship of family physical exercise. We selected three subjective indicators (including participation level, exercise purpose, influence disorder) and three objective indicators (including exercise programs, exercise instructions, sports consumption) as analysis variables, adding individual variables such as gender and age as control variables.
Results
The result shows that the exercise behavior of family member in China has different characteristics, which can be summerized as a conclusion that the elderly and youth are active in exercise while the middle-aged is not. There is obvious interaction between exercise behavior of different generations, which presents a two-way social pattern.
Discussion
The exercise participation of children in the family is high, However, the subjective enthusiasm is not high because of the pressure to pursue further study. The exercise participation of adult in the family is low and the type of exercise program is single, mainly because of heavy work load and high household pressure. We happily found that the social value of sports gradually plays a role in the family.
The complexity of the family structure affects family members' exercise behavior. Living environment has a significant effect on the exercise behavior of family members, which resents two kinds of patterns of behavior and shows two kinds of gradient evolution relations. Physical exercise behavior within a family presents a trend of homogeneity. The developing of family cohesive structure is conducive to the consistency of family physical activity. The family members who often take part in physical exercise play a leading role among the whole family.
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EFFECTIVENESS AND COST-EFFECTIVENESS OF A VERY BRIEF PEDOMETER-BASED INTERVENTION: THE VBI RANDOMISED CONTROL TRIAL

THEIL, F., HARDEMAN, W., MITCHELL, J., PEARS, S., WILSON, E., PREVOST, T., VASCONSELOS, J., SUTTON, S.
UNIVERSITY OF CAMBRIDGE

Introduction
Despite physical inactivity being the fourth leading risk factor for death worldwide, the majority of adults in England do not meet current guidelines. There is therefore a need to develop scalable physical activity interventions that can reach the greatest number of adults. Brief physical activity interventions (<30 minutes) can increase physical activity, however, little is known about very brief interventions (VBI) (<5 minutes). The aim of this trial was therefore to assess the effectiveness and cost-effectiveness of a pedometer-based very brief intervention (Step-It-Up) to increase physical activity delivered as part of the NHS preventative Health Check in primary care.
Methods
Two parallel-group randomised controlled trial with 1:1 individual randomisation, comparing the NHS Health Check with the Health Check plus Step-It-Up. Step-It-Up includes behaviour change techniques such as action planning, goal-setting and self-monitoring to encourage adults to increase physical activity through a face to face discussion, pedometer use and written materials. Physical activity was measured at 3 months using an Actigraph accelerometer with accelerometer counts per minute as the primary outcome.
Results
1007 participants aged between 40 and 74 years, were recruited from 23 GP practices in the East of England. 31% of the cohort reported that they were inactive or moderately inactive at baseline. The intervention effect for accelerometer counts per minute and step counts per day (95% CI), adjusted for gender, five-year age group and practice was 8.8 (-18.7, 36.3); p=0.53 and 242 (-172, 656); p=0.25 respectively.
Discussion
Step-It-Up did not result in significantly higher levels of physical activity at three months than the NHS Health Check alone. Potential explanations include insufficient intensity of the intervention. Step-It-Up took 5 minutes to deliver and participants did not receive any further support. Intervention fidelity may have been insufficient although our preliminary trial of three VBIs showed good fidelity of delivery. Another potential explanation is that the sample may have been too active. Participants in the control group exceeded the national average step count (3000 to 4000 steps per day – NHS Live Well). The effectiveness evaluation does not support commissioning of Step-It-Up as part of preventative health checks in primary care, however, the cost-effectiveness evaluation shows that it may be cost-effective in the long term.
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Contact
florencedtheil@live.co.uk

A PERSON-CENTERED ANALYSIS OF MOTIVATION FOR PHYSICAL ACTIVITY AND PERCEIVED NEIGHBOURHOOD ENVIRONMENT IN RESIDENTS OF ASSISTED LIVING FACILITIES

THOGERSEN-NTOUMANI, C.1, PARK, S.2, VELDHUIJZEN VAN ZANTEN, J.2, NTOUMANIS, N.1
CURTIN UNIVERSITY, AUSTRALIA (1) UNIVERSITY OF BIRMINGHAM, UK (2)

Introduction
Physical activity can offer many psychological and physical health benefits in older adults. The quality of motivation is critical to adoption and sustained participation, yet the physical environment can act as a barrier to physical activity participation in older adults. However, motivation and physical environment factors have not been considered together in the prediction of physical activity in older adults in

assisted living. Further, it is unknown how these variables cluster within individuals. Therefore, this study sought to identify profiles of individual, social and physical environmental correlates of physical activity. Moreover, the study explored differences between the identified profiles in physical activity.
Methods
Residents of assisted living facilities (N = 87, M age= 77.57 years, 66.67% female) reported their perceptions of perceived support from important others for physical activity, basic psychological needs and motivation for physical activity, and perceived physical environment around the assisted living facilities. Engagement in light and moderate-to-vigorous physical activity was measured by ActiGraph (GT3X+ and WGT3X-BT) accelerometers over a one-week period.
Results
Latent profile analysis revealed three profiles: "low self-determined and minimally supported (24%)", "moderately self-determined and supported (53%)", and "highly self-determined and supported (23%)". Subsequent difference tests showed that individuals who perceived greater autonomy support, had higher levels of self-determined motivation and psychological need satisfaction, and perceived their neighbourhood environment as more facilitative for physical activity, engaged in the highest levels of light and moderate-to-vigorous physical activity.
Discussion
Findings suggest that perceptions of the physical environment should be taken into account as well as motivation in relation to physical activity. The identified classes can be useful when considering the development of interventions aimed at promoting physical activity in older adults in assisted living settings.

CORRELATES OF PHYSICAL ACTIVITY PARENTING

LAUKKANEN, A., NIEMISTÖ, D., FINNI, T., SÄÄKSLAHTI, A.
UNIVERSITY OF JYVÄSKYLÄ

Introduction
The support parents provide to their children's physical activity (PA), i.e. physical activity parenting (PAP), has been found to be a consistent correlate of children's PA (Yao & Rhodes 2015). PAP has also been shown to moderate the effect of family-based PA intervention on children (Laukkanen 2016). Better understanding of PAP would enable one to design more effective PA interventions for children. Thus, this study aimed to examine the correlates of PAP in parents of young children.
Methods
Two to seven –years (4.94 ± 1.13 years) old children (n=912, 453 boys, 459 girls) participated in Skilled kids–project. The level of PAP (Cleland et al. 2011) and parents' education, income and PA participation, as well as characteristics of physical and social environment (e.g. indoor/outdoor PA possibilities, amount of children in the family) and the children's time spent at outdoor play, enjoyment of PA, motor competence (TGMD-3, Ulrich 2013; KTK, Kiphard & Schilling 1974) and temperament (Rowe & Plomin 1977) were assessed. Descriptives, t-tests and partial correlations with adjustment to child's age are reported.
Results
There was no difference in PAP between girls and boys. PAP associated with parent's own PA participation ($r = .300$, $p<.001$), education ($r = .125$, $p<.001$) and income level ($r = .095$, $p<.01$). Physical and social environmental characteristics were mainly not associated with the PAP. PAP associated also with children's time spent outdoors ($r = .281$, $p<.001$), enjoyment of PA ($r = .268$, $p<.001$), motor competence (KTK $r = .133$, $p<.01$; TGMD-3 $r = .082$, $p<.05$) and temperament characteristics of activity ($r = .204$, $p<.001$), reaction food ($r = -.177$, $p<.001$), soothability ($r = .169$, $p<.001$) and sociability ($r = .165$, $p<.001$).
Conclusions
Higher amount of PAP associated with higher amount of outdoor play, enjoyment of PA and motor competence in children. Physically active parents, but also parents with higher education and income level tend to provide more frequently support for their children's PA. Temperament remains relatively stable in the life course (Rowe & Plomin 1977). Therefore, findings suggest that level of PAP may be reflected based on the child's temperament. Better operationalization of PAP is needed as correlations found were generally low and longitudinal causalities with PAP would be difficult to determine.
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Oral presentations

OP-PM74 Physiology in long distance sports

COMPARISON OF PHYSIOLOGICAL STRESS BETWEEN THE FRONT SADDLE CYCLIST AND THE REAR SADDLE CYCLIST DURING A FIVE-HOUR ENDURANCE TANDEM-BICYCLE RACE

ONODERA, S.1, YOSHIDA, N.1, TAMARI, Y.1, WADA, T.1, HAYASHI, S.2, WAKIMOTO, T.1, YAMAGUCHI, H.3, YOSHIOKA, A.4, KATAYAMA, K.5, OGITA, F.6
1)KAWASAKI UNIVERSITY OF MEDICAL WELFARE, 2)FUKUYAMA CITY UNIVERSITY, 3)KIBI INTERNATIONAL UNIVERSITY, 4)OKAYAMA UNIVERSITY, 5)NAGOYA UNIVERSITY, 6)NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

Introduction
It has been thought that the physiological stress of front saddle cyclist is greater than that of the rear saddle cyclist. Actually, we reported that the relative physiological stress of front cyclist was 13% greater than that of the rear cyclist. However, it would be seemed very hard

for cyclists to keep a steady performance during an endurance race. Therefore, in the present study, we compared the physiological stress between the front cyclist and the rear cyclist during a five-hours endurance tandem-bicycle race.
Methods
Two healthy Japanese adult males (front cyclist: age, 27 years, height, 172 cm; body weight, 60 kg; and peak oxygen uptake, 32.7 ml/kg/min) and rear cyclist: age, 25 years; height, 173 cm; body weight, 88 kg; and peak oxygen uptake, 40.9 ml/kg/min) participated to a five-hour endurance race held in OKAYAMA International Circuit (3.7km around). The course was divided into three portions by undulation (A: an uphill road, B: from downhill to uphill), C: from long downhill to long uphill), and heart rate response was determined in each portion. Relative physiological stress in each subject was evaluated by the pre-determined HR- VO2 relationship for each subject. The ambient air temperature was 18°C and relative humidity was 40%.
Results
They performed twenty-two laps around a 3.7-km track in 5 hours. The mean values of relative physiological stress of the front and the rear saddle cyclist at three portions were A; front : 77%±4, rear: 72%±5, B; front: 76%±5, rear: 73%±6, C; front: 72%±5, rear: 64%±8. These results indicate that the relative physiological stress of front cyclist is greater by 3~8 percent than that of rear cyclist. These differences in physiological stress were smaller than those in a two-hour endurance race, however, it showed same tendency.
Discussion
The relative physiological stress of the front cyclist would be greater, when compared to that of the rear cyclist even during the five-hours tandem-bicycle endurance race.
This study was supported by JSPS KAKENHI Grant Number 15K01509.

WHAT DOES IT TAKE TO COMPLETE A MULTI-STAGE MOUNTAIN BIKE RACE?

ENGELBRECHT, L., TERBLANCHE, E.

STELLENBOSCH UNIVERSITY, SOUTH AFRICA

Introduction
Despite physical and physiological similarities in different cycling events, knowledge about the physiological strain of a specific cycling modality will greatly assist coaches to optimize programme design and event preparation. Power output at lactate threshold has been identified as a strong physiological predictor of MTB performance (Ahrend et al., 2016; Gregory et al., 2007). The aim of this research was to determine if this holds true for a multi-stage mountain bike (MTB) race.
Methods
21 well-trained cyclists (22-56 years old) performed a laboratory based maximal incremental exercise test prior to participating in an 8-day multi-stage MTB event (Cape Epic) during which heart rate date were collected. Heart rate and power output at lactate concentrations of 2 mmol/l (LT2) and 4 mmol/l (OBLA) were identified from the incremental exercise test. From the riders' heart rate responses during the race the percentage time spent in the low intensity zone (< LT2), moderate intensity zone (between LT2 and OBLA) and in the hard intensity zone (> OBLA) for each stage and the entire event were calculated. Final race time for each participant was selected as the dependant outcome variable.
Results
The majority of the race (72% on average) was spent in the easy intensity zone, with 22% time in the moderate intensity zone and 6% in the hard intensity zone. Absolute power output at LT2 was the best predictor of race performance (r = -0.80; CI: -0.69 – 1.01), while absolute power output at OBLA also correlated strongly with final race time (r = -0.75; CI: -0.61 – 1.00).
Discussion
Our findings concur with Padilla et al. (2001) who reported that road cyclists spent 73% of race time in the easy zone during a 3 week road race with high mountain stages, indicating the need for prolonged fatigue resistance at lower exercise intensities. The riders' distribution of exercise intensities during the MTB race supports our finding of a strong relationship between power output at LT2 and event performance, rather than power output at OBLA. In practice, riders and coaches should take cognisance that producing high exercise intensities at the lower end of the aerobic fitness spectrum contribute most to their performance in a multi-stage MTB event.
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PHYSIOLOGICAL AND BIOMECHANICAL DETERMINANTS OF PERFORMANCE IN WORLD-CLASS RACEWALKERS

SANTOS-CONCEJERO, J., TORRES-UNDA, J., GRANADOS, C., IRAZUSTA, J., GOMEZ-EZEIZA, J.

UNIVERSITY OF THE BASQUE COUNTRY UPV/EHU

Introduction
Racewalking is a unique athletic event that requires the physical and technical ability to complete long distances as fast as possible while maintaining a gait pattern in accordance with the rules of the sport (1). Despite the well-known influence of biomechanical factors on running economy and performance in running events (2), the physiological and biomechanical determinants of racewalking performance are yet to be explored.
Methods
Twenty-one world-class racewalkers from Spain, Sweden, Ireland, Australia & Canada, all possessing the Olympic qualifying standard, participated in this study. Participants completed an incremental racewalking test, starting at 10 km/h, where the speed was increased by 1 km/h every 3-minutes, with a 30 seconds recovery between stages. At 14 km/h (indicative of race pace), racewalking gait variables, including ground contact and flight times, stride length, stride frequency, and the duration of the different subphases (contact phase, foot flat and propulsive subphase) were measured. Racewalking economy was calculated as the oxygen cost per distance.
Results
Racewalking performance was related to the swing phase and the oxygen cost, being the fastest racewalkers those displaying shorter flight times (R=0.585, p=0.005) and more efficient racewalking economy (R=0.72 large effect, p<0.001). No significant relationships were found between the oxygen cost and gait characteristics, although a meaningful correlation between flight time and racewalking economy was observed (R=0.429, moderate effect).
Discussion

According to the results of this study, shorter flight times (below of what is perceptible for the human eye: 40.0 ms) may influence the oxygen cost of racewalking and improve performance. Since the rules of the sport penalise a visible lost of contact with the ground, coaches and racewalkers should avoid modifying their racewalking style by increasing flight times, as it may not only impair performance and economy, but also lead to disqualification.

Acknowledgements
This study has been supported by a grant from the University of the Basque Country UPV/EHU (EHUA16/12)

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CHANGES IN THE NUMBER AND ACTIVATION OF CIRCULATORY T-REGULATORY CELLS AFTER A MARATHON

CLIFFORD, T., WOOD, M., STOCK, P., HOWATSON, G., STEVENSON, E.J., HILKENS, C.M.U.
NORTHUMBRIA UNIVERSITY

Introduction
T-regulatory (Treg) cells are a sub-population of lymphocytes that act to supress aberrant immune responses. Recent work has suggested that Treg cells might be key drivers of immune dysfunction after prolonged exercise and that changes in the number and function of these cells might increase upper respiratory tract infection (URTI) risk. However, no study to date has investigated Treg cell mobilization in the day following a bout of prolonged, endurance exercise. Thus, the aim for his study was to characterize changes in the number and function of Treg cells, alongside leukocytes, and several pro-and anti-inflammatory cytokines in both the immediate hours and the day following a marathon race.
Methods
Blood was drawn from seventeen experienced runners (age, 40 ± 12 yrs; height, 1.75 ± 0.08 m; mass, 71.4 ± 10.8 kg; average no. of yrs running, ~16) before, ~1 h after (POST), and on the day following a marathon race (POST-1). Cytokines were measured in serum; Treg cells (CD3+CD4+Foxp3+CD25++CD127-), and those expressing human leukocyte antigen-D related (HLA-DR), an activation marker, and CD45RA+, a naïve Treg cell marker, were analysed in peripheral blood mononuclear cells (PBMC) using flow cytometry.
Results
The absolute number of Treg cells decreased (27%) POST marathon ($P<0.001$) but increased (21%) at POST-1 ($P<0.01$). Treg cells expressing HLA-DR, were unchanged at POST but significantly increased from 0.33 ± 0.11 to 0.45 ± 0.11 cells/µl at POST-1 ($P<0.01$). Naïve CD45RA+ Treg cells fell by 39% POST ($P<0.01$) but were unaffected POST-1 ($P>0.05$). There were increases in interleukin (IL)-1β (62%), IL-6 (3062%), IL-8 (136%) IL-10 (2022%) and TNF-α (15%) at POST ($P>0.05$) but all had returned to pre-exercise levels POST-1. The suppressive cytokine, transforming growth factor-beta (TGF-β), was unaffected by the marathon ($P>0.05$). There was a pronounced leukocytosis POST (160%; $P<0.001$) predominately due to a neutrophilia and monocytosis that persisted, albeit to a smaller extent, on POST-1 (21%).
Discussion
These results show that the Treg cell response to a marathon is biphasic; after initially decreasing in the early stages of recovery, possibly due to increased apoptosis or increased trafficking to other tissues, they increase the following day, presumably to limit excessive cell damage. Treg cell mobilization the day after the marathon suggests that immune suppression and, therefore, potentially the risk of URTI might be transiently heightened at this time point. The link between Treg cell activation and increased URTI requires further research.

11:30 - 12:45

Plenary sessions

PS-PL03 BACK PAIN - PREVENTION AND THERAPY IN THE MODERN SOCIETY

NEW INSIGHTS INTO MOTOR ADAPTATIONS IN LOW BACK PAIN AND NECK PAIN: IMPLICATIONS FOR SPORTS MEDICINE AND REHABILITATION

FALLA, D.
UNIVERSITY OF BIRMINGHAM

Many athletes suffer mechanical back pain and/or neck pain disorders which can affect their participation in sport and quality of life. Moreover, neck and back pain are characteristically recurrent disorders and the lifetime impact should not be underestimated. Although both disorders are heterogeneous in terms of the associated pain mechanisms, physical and psychological features, changes in movement control and muscle behaviour are an almost obligatory feature. However, motor adaptations to pain are highly variable. Contemporary research shows that motor adaptations involve a diversity of changes ranging from subtle changes in the distribution of muscle activity to complete avoidance of movement and that these adaptations are individual-specific. This knowledge has major implications for the rehabilitation of people with chronic pain. Although it is unquestionable that movement and muscle behaviour are affected in the presence of pain, the key challenge facing clinical intervention is to decide how these changes relate to an individual's presentation, which aspects require management, and how this might be best achieved.
This lecture is targeted to sport scientists and those involved in the rehabilitation of people with chronic spinal pain. By the end of the lecture participants will be able to recognize the variability of movement deficits associated with spinal pain and appreciate the scope and limitations of exercise for the relief of pain and for restoration of optimal physical function.

PHYSICAL ACTIVITY AND BIOPSYCHOSOCIAL MODULATION IN MUSCULOSKELETAL PAIN: HOW TO CONCEPTUALIZE HEALTH-PROMOTING ACTIVITY?

HASENBRING, M.

RUHR-UNIVERSITY OF BOCHUM

Chronic musculoskeletal pain (CMP), a major health problem in athletes causing substantial limitations in daily life, represents the main focus of the Medicine in Spine Exercise (MiSpEx) research network, funded by the German Institute of Sports Science (BISp). Recommendations to return to "normal" levels of physical activity (PA) and exercise are key factors in the management of CMP. However, as research has shown a U-shaped function between PA and CMP, a concept of "health-promoting" PA is warranted. The Avoidance-Endurance model of pain conceptualizes different neurobehavioral pathways involved in the development of chronic pain via extreme levels of PA. Accelerometer-based research has shown high levels of PA in individuals with elevated pain endurance coping, very low levels of PA in individuals showing fear-avoidance pathways. Research of the MiSpEx-Network shows both pathways relevant for CMP even in athletes. Understanding the mechanisms by which individual pain-response patterns can modulate pain and function will help to disentangle conflicting findings and present a translational perspective on the role of health-promoting PA. This presentation addresses researchers and clinicians in sports and rehabilitation medicine or psychology. Attendees will have opportunity for discussion of different neurobehavioral pathways, their relation to health-promoting vs. presumably detrimental aspects of physical activity and an impact on individually targeted approaches of treatment.

13:00 - 14:00

Conventional Print Poster

CP-SH03 Sport psychology 1

RELATIONSHIP BETWEEN PSYCHOLOGICAL EFFECTS AND SUBJECTIVE SATISFACTIONS BY VIEWING MOTIVATIONAL VIDEO FOR OLYMPIC ATHLETES

YAMAZAKI, M.

UNIVERSITY OF EAST ASIA

Introduction
The purpose of this study was to examine the relationship between the psychological effects of watching a motivational video and the subjective satisfaction of the same for Olympic athletes.
Methods
Participants included 6 Japanese athletes who participated in the Rio de Janeiro Olympics in 2016 (average age: 24.2 ± 3.19 years, average years of competition experience: 17.2 ± 3. 92 years). To determine the constituent elements of the motivational video, I conducted an interview with six participants and analyzed the data using the KJ method. Subsequently, I created a motivational video using these data and music. The psychological effects of the video were examined using the PCI for motivational video. This measure consists of 16 items to measure motivation and confidence. The assessment was conducted on the Olympics opening ceremony (Pre data) and on the morning of the match day (Post data). The motivational video was viewed between the collection of the pre and post data, and the psychological changes were examined. In addition, I asked the participants about the number of viewing times of the motivational video, result goal achievement level, content goal achievement level, ability achievement degree, and usefulness of the motivational video.
Results
The impact of the motivational video on the four factors of the PCI we examined using t tests, where only the general activity factor showed a significant trend ($df = 5$, $t = -2.067$, $p < .10$). No significant differences were found in the other factors compared Pre data. However, the average value indicated an increase in the score after watching the motivational video. In addition, when examining the degree of performance and usefulness of the motivational video separately, differences in the scores of each athlete were evident.
Discussion
A statistically significant difference was not confirmed owing to the small sample size. However, even in the special environment of the Olympic Games, findings similar to previous studies were revealed. In other words, it is suggested that motivational videos may be effective for encouraging Olympic athletes. In the future, it is necessary to conducted studies with a larger sample and to verify multidemontional factors about the effect of motivational video to Olympic athletes.

RELATION BETWEEN RESILIENCE AND STARTING AGE IN THEIR SPORT IN MEXICAN ATHLETES

CASTELLANOS, L.1, GUILLÉN, F.2, CANTÚ-BERRUETO, A.1, SALAZAR-GONZÁLEZ, D.1, BERENGÜÍ-GIL, R.3, RODENAS, L.1

UNIVERSIDAD AUTÓNOMA DE NUEVO LEÓN (UANL)1, MEXICO; UNIVERSITY OF LAS PALMAS DE GRAN CANARIA (ULPGC)2, SPAIN; UNIVERSITY CATÓLICA OF MURCIA (UCAM)3, SPAIN

Introduction
The aim of the study was to investigate the relationship between resilience and starting age in their sport. The resilience is defined as "the role of mental processes and behavior in promoting personal assets and protecting and individual from the potential negative effect of stressors" (Fletcher & Sarkar, 2012).
Methods
The participants of this study were of 253 athletes (143 males and 110 females), of an age range of 17 to 27 years old, mean age of 20.13 years old (SD = 2.20), practicing individual sports (athletics, tennis, aerobic gymnastics and swimming) and team sports (indoor soccer, rugby, soccer, basketball and volleyball), a mean age of start practicing in their sport of 11 years old. The scale used was Spanish version from Resilience Scale with 25 items designed to asses two factors (Personal Competence and Acceptance of Self and Life), all items are

score on a 7-point scale from 1 (disagree) to 7 (agree), the possible score range from 25 to 175 with higher scores reflecting higher resilience, all items are worded positively.
Results
The results show statistical differences between factor 1 (Personal Competence) and age of start practicing sport of t (gl) = 1.93 (251) and significance of .050 that means statistical differences, factor 2 (Acceptance of Self and Life) and age of start practicing sport of t (gl) = 3.27 (251) and significance of .001 which have a statistical difference, resilience (global scale) and age of start practicing sport of t (gl) = 2.64 (251) and significance of .009 that show statistical difference. The difference of the most significant mean was in factor 2 with 5.49 in the group of 0 to 10 years and 5.19 in the group of 11 years on.
Discussion
In conclusion with results the age of starting practicing a sport when you start practicing a sport at an early age, you can promote a more resilient person, meanwhile gender, individual sports and team sports doesn't show a statistical difference that can't reflect an impact to increase resilience.
Reference
Fletcher D, Sarkar M. (2012). A grounded theory of psychological resilience in Olympic champions. Psychol Sport Exerc, 13, 669-678.
Contact
castellanos_94@hotmail.com

STUDY OF COACH-ATHLETE RELATIONSHIP AND SUCCESSFUL MOTIVATION OF NATIONAL ARCHERS OF IRAN AND UNITED STATES.

HAJI ANZEHAEI, E.
ALLAMEH TABATABA'I UNIVERSITY

Introduction
In the body of sport, coaches are key personals that have the most affect on athletes in different aspects, and for example they are the coaches who create the suitable environment for the athletes, so that they will learn the necessary techniques and tactics for the individuals or team success and demonstrate it. Coach has the mutual affect on each member of his team, so it is the skill and management of the coach to improve the relation with the athletes that can affect on them to provide a suitable atmosphere for athletes to be valuable and useful (Jowett et al., 2005). Motivation and the relation of coaches and athletes is a bilateral process, which one affects on another (McDonald, 2010).
Methods
Research by objective the way of description and is a type of correlation that contains the interrelation of coach and athlete, the motivation of successful. In this research the player's views in regard with the relation with the coaches and motivation of their successful will be described and checked.
Results
The result of the study showed that the rate of relation between the coaches and the athletes in national archery team of Iran is at 95% confidence level down. The rate of relation between the coaches and the athletes in United States archery national team is at 99% confidence level high. The rate of successful motivation in Iran archery national team was reported at 99% confidence level high, this rate was also reported in USA archery national team at 99% confidence level high. Results showed the relationship between coaches and athletes and the successful motivation in Iran and USA archery national team there is no meaningful relation (%5) in other words the successful motivating by relation between coaches and athletes is not predictable.
Discussion
In addition to the other factors needed for success, the interaction between coach and athlete is also an important factor in achieving success, which in this research could be known as one of the factor for more success of American archers in relation with Iranian archers, the close and friendly relation between coach and archer, the most important factors of a coaches success is that they would be able to help improve the skill, and expertness of athletes especially in the dimension of physically, mentally, technically, and psychologically .
References
Jowett S, Paull G, Pensgaard. (2005). Coach-athlete relationship. Applying sport psychology (pp. 153-170). Champaign, IL: Human Kinetics
McDonald DJ. (2010). The role of enjoyment, motivational climate, and coach training in promoting the positive development of young athletes.
Contact
sima_haji@yahoo.com

Conventional Print Poster

CP-SH04 Sport psychology 2

DEVELOPMENT OF AN INSTRUMENT FOR QUALITY ASSURANCE IN COMPETITIVE YOUTH SOCCER

LOCH, F., KELLMANN, M.
RUHR-UNIVERSITÄT BOCHUM

Introduction
The major task of youth academies consists of the continuous development of their junior players pursue a career as professional players by guaranteeing an environment of optimal training conditions and support. For this purpose, in 2006 the "German Football League" developed a quality system to analyze and certify all youth academies belonging to professional teams. At present, an established scientific approach of quality assurance in competitive youth soccer lacks which clubs can implement independently. The aim of this study was to develop an instrument measuring the subjective quality assessment (satisfaction) of talent development in order to identify strengths and development potentials in youth academies in soccer.
Methods
A literary review and interviews with the directory management and parents of junior players (N = 24) were conducted to generate different dimensions precisely representing the talent development of the youth academy. Based on that, six quality dimensions (e.g. support

service, communication or facilities and equipment) with 30 statements were constructed to examine parents' satisfaction with the talent development in the youth academy of a German Bundesliga club. One hundred and three parents (U9 to U16) participated in the online survey. A principal axis factor analysis was conducted on the 30 items with orthogonal rotation (promax) and the internal consistency (Cronbach alpha) was tested.
Results
Bartlett´s test of sphericity was significant (x2 = 2004.334; df = 435; p < .001), indicating that correlations between items were sufficiently large and that the exploratory factor analysis was appropriate. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis (KMO = .889). A six-factor structure with eigenvalues ranging from 12.19 to 1.12 was identified, accounting for 67% of the total explained variance. The factor loadings ranged from .353 to .979 across the six factors. Cronbach´s alpha coefficients ranged from an unsatisfying to an excellent level (α = .65 to .94). Based on these results, test items with insufficient Cronbach alphas were eliminated or reworded and one factor was divided into two different factors (sporting support and training philosophy).
Discussion
The advanced version of the questionnaire contains seven factors (sporting support, training philosophy, support & communication, schooling, facilities for parents, training conditions & equipment, burden of sports and school) with 44 test items and the optional dimension shuttle service (6 items). Subsequent studies should retest the advanced version of the questionnaire and conduct a reliability analysis. Following a statistical development process, the model fit of the questionnaire has to be tested by a confirmatory factor analysis in prospective studies.
Contact
Fabian.Loch@rub.de

CAN REACTIVITY TO ELECTRONIC DEVICES IMPROVE SWIMMING PERFORMANCE? AN ORIGINAL STUDY

VANDONI, M.
UNIVERSITY OF PAVIA

Introduction
The use of motion sensors as pedometers or accelerometers during a week provides an increase of physical activity levels (Reactivity). Previously we demonstrated that wearing an accelerometer during a session of outdoor walking or running increases performance level among group of adults on a mixed urban and natural outdoor setting. Awareness of wearing a measuring device could affect performance in other activities increasing subjects' performance and motivation. However, no study has investigated whether this phenomenon occurs in other training contexts. Swimming is widespread among amateur practitioners and performance can be recorded by a new generation of activity trackers. This study aimed to test reactivity in acute during a session of free swimming and to verify perceived performance, effort and pleasure responses to the performance.
Methods
Twenty-one females and 27 males (age: 22.7±2.1 years; BMI: 22.8±2.7 kg/m2) volunteered in the study performing two 20-minute sessions of swimming at a self-selected speed. They wore accelerometers (A) or not (NA) in a randomized order. The main outcome to assess reactivity was covered distance, effort was measured as Rate of Perceived Exertion (RPE) with Borg 6-20 scale and Perceived Performance (PP) was recorded with a Visual Analogue Scale (VAS). Paired simple t-test was used to determine whether there was a statistically significant ($p<0.05$) difference between covered distance, RPE and PP during A and NA condition.
Results
Covered distance during A was slightly longer than during NA (831.0±210.7 m. vs 818.3±211.9 m.; p=n.s.). Subjects experienced more effort during A than NA condition (13.5±2.4 vs 12.3±2.0). Finally VAS scale didn't show differences in PP between conditions.
Discussion
Unlike to walking or running in acute condition, reactivity to accelerometers didn't occur in swimming. During a swimming training session, proper technique and water resistance affect performance more than overground. Further studies in different populations should be performed to better clarify these results.
Reference
Vandoni M, Correale L, Del Bianco M, Marin L, Codrons E (2016) Does reactivity to accelerometers occur in a single trial? Brief report in a sample of young adults. J Health Psychol.
Contact
matteo.vandoni@unipv.it

INJURY AND DISORDERED EATING BEHAVIORS: WHAT IS THE CONNECTION FOR FEMALE PROFESSIONAL DANCERS?

REEL, J., PODLOG, L., HAMILTON, L., GREVISKES, L., VOELKER, D., GRAY, C.
1. UNIVERSITY OF NORTH CAROLINA WILMINGTON, 2. UNIVERSITY OF UTAH, 3. IMG ACADEMY, 4. WEST VIRGINIA UNIVERSIT

Introduction
Dancers, like athletes, frequently endure injuries and disordered eating as a result of performance-specific demands. The purpose of this study was to extend preliminary findings (Podlog et al., 2014) by exploring the relationship between severe injuries and disordered eating from the perspectives of female professional dancers.
Methods
In-depth, semi-structured interviews were conducted with 13 female professional dancers ages 18-38 (M=23; SD=6.2) whose dance participation was suspended for 4-36 weeks (M=12.69; SD=10.09) due to a dance-related injury. We adopted a social constructivist stance to view the experiences of dancers through the lens of a phenomenon highly influenced by environmental and cultural factors.
Results
A thematic analysis yielded five themes. First, dancers reported negative emotions associated with injury such as frustration, isolation, and diminished self-worth. Second, injury-related anxieties and uncertainties were articulated regarding the deleterious physical effects of injury on dancers' bodies, uncertainties about one's dance future, and impression management concerns. The third theme, nutritional adaptions post-injury, revealed that dancers attempted to reduce calorie consumption and control food intake, disregard types and amount of food consumed, and modify their diet to promote injury recovery. The fourth theme focused on coping with injury, and included strategies such as modifying eating to maintain a lean aesthetic, training unaffected areas of the body, focusing on artistry, getting involved in alternative interests, and seeking social support. Finally, dancers discussed the need for an effective and holistic injury rehabilitation program.

Discussion
Many dancers reported compensating for their injured-state by restricting calories, emotionally eating, or finding ways to exercise non-injured parts of the body. The apparent relationship between injury and disordered eating identified by the dancers in this study is consistent with the limited body of research linking the two (Sundgot-Borgen, 1994). Findings suggest the need for sport science professionals to take a proactive approach in addressing these potential negative effects associated with severe injuries.

THE EFFECT OF ACUTE AEROBIC EXERCISE ON ATTENTION FUNCTION IN HEALTHY OLDER ADULTS

SHIMURA, Y., KOMORI, Y.
OSAKA INTERNATIONAL UNIVERSITY

Introduction
Older adults generally have lesser cognitive function than younger adults do (Park et al., 2002). Therefore, it is very important to improve cognitive function for healthy aging. Previous studies suggest that exercise training could improve cognitive function (Lautenschlager et al., 2008). Specifically, executive function, which includes inhibitory function, working memory, and cognitive flexibility is known to be enhanced by exercise (Colcombe et al., 2003). In addition, attentional function is a necessary cognitive function for safety of life too. The purpose of this study was to investigate the effect of acute aerobic exercise on attentional function in healthy older adults.
Methods
Participants were seventeen healthy older adults (72.8 ± 4.5 years). They were subjected two test conditions: exercise and control. In the exercise condition, subjects performed a color-word matching Stroop and Reverse-Stroop Test before and 30 minutes after aerobic exercise. In the control condition, subjects rested between the two sessions instead of performing exercise. The aerobic exercise occurred on a cycle ergometer at moderate intensity. Exercise intensity corresponded to approximately 50% of the maximum heart rate (HR). The pedaling rate was maintained at 50 rpm. The subject's HR and rate of perceived exhaustion (RPE) were recorded every 5 minutes to check exercise intensity. Moreover, salivary α-amylase activity was investigated as a viable biomarker for making quantitative evaluations of stress.
Results
At the end of the exercise, HR and RPE were 127.5 ± 12.2 bpm and 15.0 ± 1.7 points, respectively. Furthermore, there was a significant increase in salivary α-amylase activity in the exercise condition (pre: 10.0 ± 12.1 kU/L, post: 32.9 ± 43.6 kU/L, $p< 0.05$). In the exercise condition, subjects showed significant beneficial effects for the correct number in the first task (pre: 54.7 ± 11.6 points, post: 58.1 ± 12.0 points, $p< 0.05$), third task (pre: 36.3 ± 8.6 points, post: 39.5 ± 8.7 points, $p< 0.05$), and fourth task (pre: 30.0 ± 11.2 points, post: 33.9 ± 10.5 points, $p< 0.05$). However, in the control condition, subjects showed significant improvement only in the first task (pre: 49.3 ± 13.1 points, post: 54.4 ± 12.8 points, $p< 0.05$) and third task (pre: 33.2 ± 7.3 points, post: 37.1 ± 10,1 points, $p< 0.05$). However, there were no significant differences in Stroop and Reverse-Stroop interference between conditions.
Discussion
This study suggests that acute aerobic exercise improves attentional function in older adults. Thus, it might be an effective method for reducing word interference.
References
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Lautenschlager et al. (2008) JAMA. 300, 1027-1037.
Colcombe et al. (2003) Psychol Science. 14, 125-130.

SOCIAL COGNITIVE THEORY AND PHYSICAL ACTIVITY AMONG KOREAN MALE HIGH SCHOOL STUDENTS

LEE, C.G.
SEOUL NATIONAL UNIVERSITY

Introduction
The most critical step in developing and implementing effective physical activity interventions for adolescents is to understand the determinants and correlates of physical activity and it is strongly suggested that such effort should be based on theories because a-theoretical approach often shown to be ineffective. The purpose of this study is to use structural equation modeling to test the direct, indirect, and total effect of social cognitive theory constructs on physical activity among Korean male high school students. We focused on male adolescents only because male participants were substantially under-represented in previous studies that used social cognitive theory to predict physical activity.
Methods
Three-hundred and forty-one tenth-grade male students were recruited from a private single-sex high school located in Seoul, South Korea. The confirmatory factor analysis was used to test an overall measurement model that included five correlated latent variables (i.e., self-efficacy, perceived benefits, perceived barriers, goal-setting, and physical activity). We then used structural equation modeling to test the expected relationships among the latent variables.
Results
The measurement model represented the data accurately. Fit indices indicated that the proposed theoretical model fits the data ($x2 = 2897.399$ [$df = 1119$, $p < .01$], RMSEA = 0.068, SRMR was 0.082, and CFI = 0.833). The proposed model explained 17% of the variance in perceived benefits of physical activity, 18% of the variance in perceived barriers to physical activity, 35% of the variance in goal setting, and 42% of the variance in physical activity. The self-efficacy exerted the strongest total effect on physical activity. Self-efficacy for being physically active was positively associated with perceived benefits ($\beta = 0.408$, SE = 0.049, $p < .01$), goal setting ($\beta = 0.583$, SE = 0.050, $p < .01$), and physical activity ($\beta = 0.461$, SE = 0.061, $p < .01$) and negatively associated with perceived barriers to physical activity ($\beta = -0.421$, SE = 0.050, $p < .01$). Perceived barriers to physical activity was positively associated with goal setting ($\beta = 0.115$, SE = 0.056, $p < .05$). Both goal setting ($\beta = 0.171$, SE = 0.062, $p < .01$) and perceived benefits ($\beta = 0.143$, SE = 0.055, $p < .01$) were positively associated with physical activity.
Discussion
The results of this study indicated that the social cognitive theory is a useful framework to explain physical activity among Korean adolescents. Since the self-efficacy exerted the strongest total effect on physical activity, physical activity interventions targeting Korean male high school students should focus on the four major sources of efficacy (i.e., mastery experience, vicarious experiences, verbal persuasion, and physiological arousal).

THE EVASKIP-STUDY: IS PHYSICAL PERFORMANCE AND HEALTH RELATED QUALITY OF LIFE ASSOCIATED WITH DIFFERENT SCHOOL TYPES IN GERMANY?

SCHULZ, T., THOMANDL, L., GRAF, C., ENGL, T., POSTLER, C., OBERHOFFER, R.
*TECHNISCHE UNIVERSITÄT MÜNCHEN; *GERMAN SPORT UNIVERSITY COOGNE*

Introduction
Studies in youth highlight that physical activity (PA) and performance (PP) are associated with a range of health outcomes. E.g., PA has been found to be associated with lower BMI and lower risk for being overweight. Furthermore, obese children have been found to have lower health related quality of life (HRQoL) and to have poorer levels of academic achievement. Therefore the purpose of this study was to examine if different school types in Germany are associated with physical performance and health related quality of life.
Methods
Data of 764 children and adolescents (52.7% male) aged 9 to 16 years was collected in 2015. PP was measured by standing long jump (SLJ), 20m sprint ability, 6min run (SMR), stand and reach (SR) and lateral back and forth jumps (LBF). Health related quality of life was collected according to KINDL-R. School types were so called "Mittelschule" (MS) (n=217), "Realschule" (RS) (n=220) and "Gymnasium" (G) (n=320). To exclude age related differences, the measured values were transformed into a z-score. Group comparisons were performed with one factorial ANOVA, correlations were calculated by Pearson correlation test.
Results
School types in Germany differ in the average values of the transformed parameters: the BMI of the MS-pupils were higher than those of the RS ($p<0.005$) and G ($p<0.001$). No difference could be observed between RS and G. Physical performance related parameters showed similar results: the 6 min run of the MS-pupils showed lower performance than the children of RS ($p<0.000$) and G ($p<0.000$). For sprint performance, the coordination parameter LBF as well as for SLJ and the flexibility test SR the MS-pupils showed significant reduced values in comparison to RS and G whereas RS and G did not differ. The values of the HRQoL did not differ in the total HRQol-score and the different subscales except the subscale school 100. Here, significant lower values in MS were found. Pearson analysis between all health related parameters and the school types showed significant correlations: physical performance (e.g.: SLJ r=0,314; LBF r=0,346, SMR r=0,267) and HRQoL (r=0,105) is increasing with the "higher" educational school type.
Discussion
Higher educational school types in Germany are associated with a better physical performance, reduced BMI and a higher HRQoL or vice versa the lower the school type the lower the physical fitness and HRQoL. Therefore, not only health programs should focus more on the physical performance. Especially lower educational school types seem to have the opportunity to change health related parameters through more physical activities, maybe also cognition parameters.
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This study was founded by the BMBF.

Conventional Print Poster

CP-BN04 Coordination and motor control

LINKING COLLECTIVE VARIABLE, SYNERGIES AND TASK OUTCOME: THE ROLLERBALL EXAMPLE

LIU, Y., CHUANG, K., NEWELL, K.
1:NATIONAL TAIWAN NORMAL UNIVERSITY 2: UNIVERSITY OF GEORGIA

Introduction
Collective variable (order parameter) reflects the qualitative integrative functional aspect of the movement coordination pattern that is task specific (Kelso, 1995). However, the identification of the collective variable for tasks with multiple joint space DFs is not such a straightforward enterprise as the determination of relative phase of 2 DFs as in 2 planar finger motions (i.e. Haken, Kelso, & Bunz, 1985). Rollerball is a gyroscopic exercise tool that may be held in the hand and the inner ball can be speeded up with the appropriate wrist movement. Due to the unique characteristics of the rollerball, the outcome of the rollerball task has been used to analyze the between-trial learning dynamics (e.g., Liu & Newell, 2015). The purpose of the study was to explore the collective variable of the rollerball task and the relation between the collective variable and the wrist movement synergies that produced the success or failure of the task.
Methods
Sixteen young adults with no neuromuscular disorder volunteered in the experiment. Each participant performed fifty 10-second trials of rollerball task in 5 different initial speeds. Participants were asked to use their right hand to hold the rollerball and try to speed up the rollerball. It was considered a failure performance if the spinning speed of the rollerball dropped below the initial speed at the end of the 10-second trial. Three high-speed cameras were used to capture movement of the outer shell and inner ball of the rollerball. The rollerball spinning speed was recorded through a fiber-optic system connected to a computer. The wrist motion was qualitatively categorized and the cross correlation with lags up to a quarter of a period of the inner ball movement was performed on the movement velocity of the outer shell and the inner ball. Paired t-test was used to compare the coefficient of correlation between the success and failure trials.
Results
We identified 5 basic wrist movement patterns used in performing the rollerball task. Furthermore, these movement patterns all produced success and failure trials. The paired t-test on the coefficient of correlation showed a significant difference between the success and failure trials. The correlation between the outer shell and inner ball of the success trials were higher than that of the failure trials.
Discussion
The high coefficient of correlation of the successful trials indicates that certain phase relation between the outer shell and the inner ball was needed for a successful rollerball performance. This relative phase between 0 and 90 degree may be a candidate collective variable for the rollerball task. The observed 5 different wrist movement patterns corresponded to both success and failure performances demonstrate movement degeneracy of the rollerball task.
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IDENTIFYING UNITS OF DISCRETE MOVEMENT IN SPACE-TIME CONSTRAINTS

TSUNG-YU, H., YEOU-TEH, L., KARL, M.N.
NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction
Starting from Woodworth's (1899) seminal study the role of submovements during aiming movements has been a focus concerning the accuracy and control of human movements. Traditionally, submovements in the final portion of movements have been viewed as accuracy adjustments or movement corrections. However, by manipulating movement mode (discrete, reciprocal, and passing tasks) and target size (small and large), the number of submovements and/or different types of submovements might result from particular task constraints (e.g., Fradet, Lee, & Dounskaia, 2008). The purpose of present study was to systematically manipulate the different time and space criteria to provide a comprehensive test of movement velocity effects on the properties of submovements.
Methods
Twelve participants completed 3 distances x 5 time conditions each with 100 trials in line drawing task and the order of different space-time conditions was randomly assigned for each participant. We measured the kinematic structure of the trajectory by implementing the algorithm described by Chua and Elliott (1993) to examine the quantity and type of submovements (no submovement, type 1 & 2: overlapped with increasing and decreasing movement velocity, type 3: undershoot, and type 4: overshoot). Repeated measures ANOVAs were used to examine dependent variables.
Results
There was a significant interaction of movement amplitude and space-time conditions for number of submovements ($p<.05$). The interaction effects of different types and space-time conditions also reached significance at the 10 cm, 20 cm, and 30 cm amplitude, respectively ($p<.05$).
Discussion
The findings showed that the number of submovements increasingly arise in the slower time matching space-time conditions that may be characterized as motion fluctuations (type 2) rather than corrective submovements. In addition, corrective submovements (type 3 & 4) were more frequently observed in high-speed conditions that may be viewed as reflecting the role of accuracy regulation. Overall, our results show different properties and prevalence of submovements in discrete aiming tasks as a function of movement speed and the space-time constraints.
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THE IMPACT OF VISUAL OCCLUSION ON THE KINEMATICS OF THE BASKETBALL DRIBBLE

DUNTON, A., O' NEILL, C., JERMYN, S., DAWSON, D., COUGHLAN, E.K.
CORK INSTITUTE OF TECHNOLOGY

Introduction
Visual Occlusion is the process of limiting the vision of an object, limb or critical information source from the visuomotor workspace (Vickers, 2007). As a result of this, adverse effects on performance are expected. The purpose of the current study is to assess the impact of visual occlusion on the kinematic consistency of the basketball crossover dribble.
Methods
Fifteen male basketball players, with a minimum of 10 years playing experience, were recruited for this study. Participants were randomly assigned to one of three groups: Occlusion (OCC), Practice (PRA), and Control (CON). An eight camera (MX13+) Vicon motion analysis system was utilised for analysis in addition to full body kinematic modelling (Van Sint Jan, 2007). The study design consisted of a pre-test, an acquisition phase (400 dribble sequences), a post-test and a 2-day retention test. Participants were instructed to complete a crossover dribble sequence in a forward motion consisting of two dribbles with the same hand, followed by a third dribble across their body. This sequence was repeated twice per trial with 5 trials per test session. Each participant was counterbalanced to prevent limb dominance bias.
Results
There was a significant improvement in kinematic consistency for the OCC group in elbow angles of the dominant and non-dominant side from pre-test to post-test ($p < 0.05$) and from pre-test to retention test ($p < 0.05$) demonstrating a practice effect. No significant improvement was found from post-test to retention test ($p > 0.05$) demonstrating a learning effect. There was no significant improvement evident for elbow angles for the PRA group ($p > 0.05$) or the CON group ($p > 0.05$) across any test.
Discussion
This study occluded the lower limbs during the basketball dribble which positively impacted the kinematic consistency in the OCC group. This result is consistent with the findings of Williams et al. (2002) where participants who completed an explicit instruction acquisition phase which included training with a temporal occlusion paradigm improved performance in a tennis task. The current study provides further insight into the applied use of visual occlusion paradigms in real world tasks.
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Contact
alan.dunton@mycit.ie

THE RELATIONSHIP BETWEEN GOLF PUTTING PRECISION AND VARIABILITY IN INITIAL BALL DIRECTION AND VELOCITY

MIYAKE, Y., FUJIMOTO, M., ISAKA, T.

RITSUMEIKAN UNIVERSITY

Introduction
Putting ability appears to be important skill in determining earnings in golf competition which accounts for approximately 40% of strokes during the game (Gwyn and Patch, 1993). Putting requires precise control of the magnitude and direction of the applied force at impact, which determines initial ball direction and velocity. Variability in initial ball direction and velocity seems to be contribute to the overall direction variability, affecting putting precision. However, no research has reported the relationship between putting precision and such variability. This study investigated relationship between golf putting precision and variability in initial ball direction and velocity.
Methods
Three collegiate golf players (subjects A, B and C) executed putting on a carpet without undulation. A circle was painted in black, the subjects were instructed to make each putt, leaving the ball as close as possible to the circle. 3D coordinates of the ball were obtained using two high speed cameras with the DLT method. SD of the putted position in the horizontal and longitudinal direction was calculated to assess putting precision. SD of the magnitude and direction of the ball velocity vector right after the impact was calculated as initial ball direction and velocity.
Results
The subject A demonstrated the largest SD in the horizontal direction (A: 5.3 cm, B: 0.9 cm, C: 2.4 cm), while the subjects B showed the largest SD in the longitudinal direction (A: 15.0 cm, B: 23.0 cm, C: 12.1 cm). The subject C demonstrated the largest SD in the initial ball direction (A: 0.52 deg, B: 0.50 deg, C: 1.07 deg), whereas the subject B demonstrated the largest SD in the initial velocity (A: 0.10 m/s, B: 0.17 m/s, C: 0.09 m/s).
Discussion
The subject B demonstrated the largest variability both the initial ball velocity and putted ball position in the longitudinal direction. Since the initial ball velocity would determine the ball roll distance in the longitudinal direction, variability in the putted ball position in the longitudinal direction appears to be related to that in initial ball velocity. In contrast, the subject C showed the largest variability in initial ball direction, while the subject A demonstrated in the largest variability in the putted ball position in the horizontal direction. Although initial direction of the ball velocity vector would determine the initial ball direction, spin imparted to the ball would also affect the ball trajectory, correcting the ball direction. The subject C may have been able to correct ball direction, which was initially deviated from the target direction, by applying appropriate spin to the ball. Further analysis is currently underway with a larger sample size.
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Contact
sh0067ri@ed.ritsumei.ac.jp

OVERESTIMATION OF SUCCESS-RATE IS STRONGER IN MOTOR CONDITION THAN IN EQUIVALENT NON-MOTOR CONDITION IN TWO-CHOICE DECISION TASK

ONAGAWA, R., SHINYA, M., OTA, K., KUDO, K.

THE UNIVERSITY OF TOKYO

Introduction
In many sports, correct estimation of own motor variance is one of the critical factors for superior performance. Previous studies on motor planning have shown that humans have difficulty in decision making to maximize expected gain, on the basis of their own motor variance (Ota et al., 2016). This perception of the sensory consequences of their own actions is biased toward success (Wolpe et al., 2014). Therefore, the context of decision-making (motor vs. non-motor) may affect this difficulty. Here, we compared decision-making of two-choice decision task in motor condition with that in equivalent non-motor condition.
Methods
Eight participants performed the two-choice decision task requiring for them to decide whether to shoot toward a target or not. In each trial, amount of rewards (65, 70, 75, 80, 85, 90 or 95 points) was randomly assigned. If the participants chose to shoot and hit the target, they received the assigned rewards. If they missed, no rewards were given. If they did not shoot, they received fixed amount of rewards (60 points). In motor condition, the shooting direction was determined by swiping index finger on a touchpad. In non-motor condition, the shooting direction was determined by random Gaussian noise of which variance was equal to motor variance. We calculated the probability of hitting the target (success rate) and then estimated the point of objective equality (POE) in which the objective expected rewards was equal to the fixed amount of rewards. We next calculated the probability of shooting the target for each reward (shooting rate) and estimated the point in which the participants decided to shoot with 50 %. This point is regarded to be subjectively equal to the fixed amount of rewards, and is defined as the point of subjective equality (PSE).
Results
In both conditions, PSE (motor condition: 68.0 ± 7.8 points, non-motor condition: 77.4 ± 5.7 points) was less than POE (motor condition: 80.0 ± 5.7 points, non-motor condition: 81.3 ± 2.0 points), suggests that the participants failed to maximize the expected rewards. Furthermore, the absolute difference between PSE and POE in condition was larger than that in Random noise condition.
Discussion
These results suggest that participants overestimate their success rate of shooting the target due to underestimation of their own motor variance in motor context, and that decision-making is less optimal in motor context than in equivalent non-motor context.
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Contact
ryojioanagawa@gmail.com

INFLUENCES OF LONG-TERM MOTOR TRAINING ON THE EXCITABILITY OF THE CORTICOSPINAL TRACT DURING DUAL-TASK

FUKUMOTO, H.1, NISHIHIRA, Y.2, FUMOTO, M.3, USUI, S.3

1: SEIWA UNIVERSITY(CHIBA, JAPAN), 2: UNIVERSITY OF TSUKUBA(IBARAKI, JAPAN), 3: TOKYO INTERNATIONAL UNIVERSITY(SAITAMA, JAPAN)

Introduction
Although the implementation of dual-tasks involving motor and cognitive activities is needed in both daily life and sports, the excitability of the corticospinal tract during such tasks has remained unclear. Moreover, the flexible plasticity of primary motor cortex(M1) and the corticospinal tract has recently been reported, but changes in the excitability of the latter during dual-tasks performed by individuals who have been engaged in sports for a long period have rarely been examined.Therefore, the aim of this study was to examine the influence of long-term motor training on corticospinal tract excitability when implementing dual-tasks, based on the motor evoked potential (MEP) induced by transcranial magnetic stimulation (TMS).
Methods
An experiment was conducted, involving 12 athletes and 12 non-athletes to implement tasks under the following 4 conditions: 1) Rest: resting; 2) Calc: calculating; 3) ST: undergoing a hand grip strength test with 10 or 30% MVC; and 4) DT: simultaneously conducting 2) and 3) to record the MEP and The background EMG area (bEMG).
Results
The MEP amplitude was significantly greater in the athlete compared with non-athlete group, regardless of the muscular utilization level and task. Furthermore, in the former compared with the latter, changes in the MEP amplitude (dual-task interference) were less marked. No significant difference was found in the bEMG between the 2 groups.
Discussion
As the bEMG was not difference between the 2 groups, the differences in the MEP amplitude between them may be explained by plastic changes in the upper spinal cord (Kasai T, 2004), including M1, related to long-term motor training. The results suggest that long-term motor training reduces the degree of dual-task interference, and leads to plastic changes in the upper spinal cord, including M1.
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CHANGES IN BRAIN GRAY MATTER VOLUME IN UNIVERSITY-LEVEL SOCCER PLAYERS

KAMIBAYASHI, K., MIYANARI, S.

DOSHISHA UNIVERSITY

Introduction
Structural changes in adult human brains due to intense training for several months in juggling (Dragansiki et al. 2004) and a complex visuomotor task (Scholz et al. 2009) have been reported using magnetic resonance imaging (MRI) techniques. Additionally, increased gray matter volume has been identified in brains of professional handball players when compared with control subjects (Hänggi et al. 2015). As specific motor skills for controlling lower-limb movements are particularly necessary in soccer, more so than in other sports, changes in cortical structure may be observed even in university-level soccer players due to intensive practice, often starting in childhood. The purpose of this study was to investigate whether structural brain differences are observed between university soccer players and non-soccer players using voxel-based morphometry (VBM).
Methods
The subjects in this study were male soccer players and age-matched, healthy control participants from a Japanese university. Three-dimensional T1-weighted images of whole brain (1 × 1 × 1 mm voxels) were acquired on a 1.5T MRI scanner. Images were analyzed using the VBM toolbox in the SPM 12 software package. First, the images were segmented into gray matter, white matter, and cerebrospinal fluid. The images were spatially normalized to a customized DARTEL template, nonlinearly modulated to preserve relative differences in regional volumes of gray matter, and then spatially smoothed with a Gaussian kernel. Normalized volumes for gray matter, white matter, and cerebrospinal fluid were calculated by dividing each volume by the total intracranial volume of each participant.
Results
Normalized volumes of gray matter, white matter, and cerebrospinal fluid were similar between the soccer and control groups. However, the VBM analysis indicated regional gray matter volume differences in the cerebral cortex between the two groups. Compared to the control group, the soccer group showed an increase of gray matter volume in the premotor areas. In addition, increased gray matter volume was found in the paracentral lobule in soccer players.
Discussion
In the present study, structural differences in the volume of gray matter between soccer players and control participants were observed. Increased gray matter volume in the paracentral lobule might be connected with the foot and leg representation area in the primary motor cortex. Thus, the present study revealed structural changes in the cerebral cortex associated with long-term soccer training.
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Contact
kkamibay@mail.doshisha.ac.jp

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ACUTE EFFECTS OF A SPECIFIC POST-ACTIVATION POTENTIATION PROTOCOL ON SWIMMING START PERFORMANCE OF COMPETITIVE SWIMMERS

VIEIRA, L., PEREIRA, S., QUINAN, G., SANTOS, S., SHANG, F., PENNA, E., COUTO, B., PRADO, L.
FEDERAL UNIVERSITY OF MINAS GERAIS

Introduction
Performance during the start is determining of overall success in competitive swimming, specially in short-distance events. Preparatory muscle activities prior to the aimed sports action are believed to enhance performance (PAP), and various mechanisms have been proposed to explain this. Furthermore, it is suggested that the specificity of muscle action in the exercise protocol conceived to trigger a PAP may be of relevance. Aim of the present investigation is to test the effectivity of to specific protocols (a specific and a non-specific protocol) designed to achieve a PAP on enhancing swimming performance.
Methods
Our sample was composed by 5 female and 7 male national level swimmers (age 20.8 ± 3.0 years; height 173.1 ± 6.79 cm; weight 66.5 ± 5.53 kg). They carried out 3 maximal 50 meter crawl sprints in different days, prior to which they underwent 3 different preparatory exercise protocols: a control situation with no prior exercise (Control); a non-specific protocol consisted of 3 sets of isometric squats (Squat) and a specific protocol, in which subjects performed 3 sets of maximal isometric contractions in the start position (attached to a wooden start block) (Specific). The test conditions were randomized. Starts were recorded by cameras placed alongside the pool. Horizontal start velocity and 15 meter swimming time were recorded.
Results
No significant differences were observed in horizontal start velocity between situations. However, after performing the specific preparatory exercises, 15m swimming times were significantly shorter ($p<0.05$) (Control: 7,221 ± 0,411s; Squat: 7,245 ± 0,425s; Specific 7,148 ± 0,442s).
Discussion
Shorter swimming times were observed after the specific preparatory exercise protocol, even though horizontal start speed showed no alterations. The underwater phase is not expected to be influenced by specific start preparatory exercises. Therefore, we expect that other variables influencing start performance may have changed, like reaction time, distance of the flight phase or impulse, which might explain the improved 15m swimming times.
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INFLUENCE OF POLYURETHANE MIDSOLE ON GROUND REACTION FORCE DURING STRETCH-SHORTENING-CYCLE MOVEMENT

NORO, H., SUGIMOTO, R., TAKESHITA, T., YOSHIDA, T., YANAGIYA, T.
JUNTENDO UNIVERSITY

Introduction
EVA has been used from 1980's to nowadays as a material of shoe sole. Having greater resilience and shock attenuation compared with EVA, the share of polyurethane (PU) has gradually increasing. The resilience and shock attenuation of PU was reported over 53% and 15% higher compared with EVA, respectively (Achilles corp., 2016). Then, we thought that this higher shock attenuation and resilience might take it advantage especially for stretch shortening movement during counter movement action seen in sports. Forward lunge movement is one of the counter movement actions, seen in ball game or racket sports. Forward lunge is constructed, as rapidly stopping and returning as soon as possible, so many burdens on lower limb will be imposed. Therefore, greater resilience and shock attenuation with PU may help athletes performing higher level. Thus, the purpose of this study was to compare the magnitude of shock attenuation and reuse in the counter moment action between EVA and PU.
Methods
Subjects of this study were seven male university students. They had forward lunge followed by 5m running according with electrical pacemaker, with two shoe midsole conditions, EVA and PU, respectively. There located force plate (0.9mx 0.6m) at the turning point of forward lunge. Ground reaction force in forward leg during forward lunge was recorded at 1200 Hz. Motions were captured from right side with digital video camera at 300 fps. Right greater trochanter point was digitized using computer software to quantify the distance of forward and backward of the body. The impulse and magnitude of ground reaction force in forward-backward direction were compared among shoe midsole conditions.
Results
Significant differences in the magnitude of anterior-posterior force were seen at 30 and 40% of forward phase, and 70% of backward phase among shoe midsole conditions, though there was no significant difference in impulse difference between forward phase and backward phase.
Discussion
Results of this study suggested that PU might attenuate shock during forward lunge compared with EVA, though resilience didn't change. The advantage of PU as a midsole material assist muscle activation during counter movement exercise in lower limb, though muscle activation didn't measure in this study.
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Contact
nororopokuru@hotmail.co.jp

CO-CONTRACTION AND SSC IN VOLLEYBALL OVERHEAD PASS

OZAWA, Y., YAMADA, H., UCHIYAMA, S., KANOSUE, K.
WASEDA UNIV., TOKAI UNIV., TOKAI UNIV., WASEDA UNIV.

Introduction
In volleyball overhead pass is an important skill for passing a ball, covering tips, and setting a ball to attackers. The higher the performance of setters is, the higher the performance of attackers (Nikolaos et al. 2009). In this research, we investigated movements of elbow and wrist, and analyzed the electromyography (EMG) of muscles of these joints during the overhead pass. We had two hypotheses. 1) Better performance in overhead pass could accomplished with Stretch Shortening Cycle (SSC) that occurs in the pull phase, and 2) expert players exhibit less co-contraction of the elbow and wrist than novice players.
Methods
Twenty male subjects participated in this study. Half of them were top level university volleyball players (Skilled), and the other had no experience of volleyball (Unskilled). Subjects were told to pass a ball with overhead pass into a ring (diameter: 1 m, height: 2.43 m) set at 6 meters ahead from a subject. Forty-one reflective markers were placed on the ball and the subject's body to calculate joint center and joints angle. EMG was recorded from the Triceps Brachii (TB), Biceps Brachii (BB), Extensor Carpi Ulnalis, and Flexor Carpi Radialis (FCR). EMG was expressed with the percent of the EMG / the MVC.
Results
In the pull phase, the activity of TB was larger (Skilled : 44.1 ± 29.2 %, Unskilled : 49.1 ± 20.0 %) than BB (Skilled : 3.3 ± 19.0 %, Unskilled : 4.2 ± 3.1 %) in both groups. There were no differences in these activities between two groups. In the push phase the TB activity in the Skilled (15.5 ± 9.4 %) was significantly lower than that of the Unskilled (32.8 ± 12.4 %), ($p<0.01$). The Skilled showed greater co-contraction of the TB and BB (56.9 ± 9.4 %) than the Unskilled (36.4 ± 21.1 %), ($p<0.05$). The wrist of both groups was extended in the pull phase and the FCR activity in the Skilled (51.5 ± 20.1 %) was higher than the Unskilled (34.0 ± 16.9 %) in this phase, ($p < 0.05$). The Unskilled showed greater co-contraction of FCR and ECU than the Skilled (Skilled : 25.1 ± 8.0 %, Unskilled : 38.3 ± 17.2 %, $p<0.05$).
Discussion
The degree of freedom of the body decreases with co-contraction of agonists and antagonists (Gribble et al., 2003). The stronger elbow co-contraction in the Skilled than the Unskilled suggests that the skilled players used the elbows as the stabilizer. The TB activity in the Unskilled were higher than the skilled suggesting that the Unskilled pushed the ball mainly by using the elbow. On the other hand, the Skilled pushed the ball utilizing the SSC in the FCR.
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BICEPS BRACHII MECHANOMYOGRAPHIC AND ELECTROMYOGRAPHIC ACTIVITY CHANGES AFTER ECCENTRIC EXERCISE OF THE ELBOW FLEXORS

SHIMA, N.1, MURAYAMA, M.2, INAMI, T.3, NOSAKA, K.3.
1: TOKAI-GAKUEN UNIVERSITY (JAPAN), 2: KEIO UNIVERSITY (JAPAN), 3: EDITH COWAN UNIVERSITY (AUSTRALIA)

Introduction
Mechnomyogram (MMG) represents low-frequency oscillations of active muscle fibres [1]. A previous study reported that MMG amplitude during maximal voluntary isometric contraction (MVC) increased immediately after trapezius muscle eccentric exercise, but returned to baseline at 1 day post-exercise. The authors suggested that this was due to neuromuscular changes associated with pain and increased muscle stiffness [2]. However, no previous study has examined changes in MMG of elbow flexor muscles that performed eccentric exercise, and MMG during submaximal isometric contractions has not been investigated. The present study examined changes in MMG and electromyogram (EMG) of biceps brachii during maximal and submaximal isometric contractions before, immediately after and 1-4 days after eccentric exercise of the elbow flexors.
Methods
Ten men (20-34 y) performed 5 sets of 10 eccentric contractions of the elbow flexors using a dumbbell that was set at 80% of MVC at 90° elbow flexion. Surface bipolar EMG electrodes were placed at the mid-belly of the biceps brachii, and an accelerometer to record MMG was placed between the electrodes. Torque, EMG and MMG signals were recorded to a computer at a sampling rate of 2 kHz when the muscle was producing MVC and 15%, 30% of the baseline MVC, and 30%MVC of the day at 90° elbow flexion. Root-mean-square (RMS) of the MMG and EMG signals was calculated for 0.5 s during the target force was achieved, and normalised by RMS during MVC. A one-way ANOVA was used for changes in MVC over time, and the changes in RMS over time between MMG and EMG, followed by a Dunnett's post-hoc tests for the difference from the baseline value.
Results
MVC torque (mean ± SD) decreased immediately (-50 ± 18%) to 4 days after exercise (-29 ± 22%). A significant interaction effect was evident for the changes in RMS between MMG and EMG. Normalised EMG-RMS during 15%MVC showed an increase at immediately (43%) and 1 day post-exercise (22%) from the pre-exercise value. Normalised EMG-RMS during 30%MVC showed an increase at immediately (65%) to 4 days post-exercise (29%) from the baseline. In contrast, normalised MMG-RMS during 15%MVC and 30%MVC showed an increase at immediately (19% and 49%, respectively) and 1 day (9% and 19%, respectively) post-exercise from the pre-exercise value. No significant correlation between the magnitude of changes in MVC and the magnitude of changes in EMG or MMG was found.
Discussion
These results showed that MMG returned to the baseline faster than EMG. Since MVC was still lower than the baseline at 4 days post-exercise, it seems likely that muscle did not recover from damage at this time point. The faster recovery of MMG may suggest that MMG is less sensitive than EMG to indicate neuromuscular changes after eccentric exercise.
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CAFFEINE AMELIORATES THE TRANSIENT DEPRESSION OF FORCE FOLLOWING UNILATERAL RESISTANCE EXERCISE IN TRAINED ADULT MALES

DAVIES, R.W., CARSON, B.P., JAKEMAN, P.J.

UNIVERSITY OF LIMERICK

Introduction
Following strenuous but familiar resistance exercise (RE), a temporary post-depression of contractile force (PCD) occurs through other mechanisms independent from muscle damage. During the period of PCD where the muscles supporting structures and contractile proteins remain intact, caffeine potentiates force production ameliorating PCD. The purpose of this study was to investigate the effect of caffeine ingestion immediately following non-damaging RE on PCD in vivo.
Methods
Following familiarisation, six healthy, RE trained male subjects completed two matched bouts of RE on each limb. Immediately following each RE bout, subjects were randomly allocated to receive a caffeine or sham beverage (6mg · kg-1) in a blocked double-blind, counter-balanced design. Knee extensor isometric contractile force was evaluated for both RE and non-RE limbs prior to RE (PRE), immediately following RE (POST) and 1h following caffeine or sham ingestion. Data is mean [low : high] CI.
Results
PCD of maximal volitional force was observed POST following both experimental trials and 1h in the sham condition (-11 [-14 : -9] %, $p < 0.001$, $d = 4.7$). 1h following caffeine ingestion PCD was ameliorated (1 [-3 : 6] %, $p = 0.501$, $d = 0.3$). No change was observed 1h in the caffeine non-RE limb (2 [-7 : 11] %, $p = 0.635$, $d = 0.2$). During the early epoch of the isometric contraction (< 150ms) caffeine augmented contractile force in the RE-limb over and above baseline, the caffeine non-RE limb and the sham-RE limb. In conjunction with this, using surface electromyography an early (< 100ms) increase in voltage of the caffeine-RE limb was observed
Discussion
These data support the hypothesis that caffeine ameliorates PCD following RE, and where PCD is absent, caffeine may interact with RE potentiating contractile force within the early developmental phase of muscle contraction.

THE EFFECT OF SEX AND MOTONEURON POOL ON CENTRAL FATIGUE

YACYSHYN, A.F., NETTLETON, J., MCNEIL, C.J.

UBC (KELOWNA, BC, CANADA)

Introduction
It is uncertain if sex influences fatigue within the nervous system (central fatigue) as the reduction in voluntary activation (VA) was not different between the sexes for the elbow flexors (EF; Hunter et al. 2006) but was greater in males (M) compared to females (F) for the knee extensors (Martin & Rattey, 2007). This disparity could be related to the differential effects of group III/IV muscle afferents on flexor vs. extensor motoneurons (Martin et al. 2006). The purpose of this study was to examine central fatigue and motoneuron responsiveness of the EF and elbow extensors (EE) in M and F.
Methods
Eleven M (23.0±2.7y; mean ± SD) and nine F (21.8±2.8y) performed a 2min isometric MVC of EF and EE (on separate days) followed by a recovery period of 2min. Electromyographic potentials were recorded from the biceps or triceps brachii in response to stimulation of the corticospinal tract (cervicomedullary motor evoked potentials; CMEPs) and the brachial plexus (maximal M-wave; Mmax). Superimposed (SIT) and resting twitches (RT) were evoked via motor point stimulation (MPS) of biceps brachii (EF day) or triceps brachii (EE day). CMEPs were normalized to pre-fatigue values, with control amplitude targeting 33% of Mmax. Throughout the fatiguing effort cervicomedullary stimulation was delivered every 15s. VA was calculated from brief MVCs in the recovery period.
Results
Control VA was not different between the sexes for EF and EE (95.9±3.3% and 96.4±3.3% of control, respectively). The reduction in torque was greater for M than F for EF (30.1±9.1% and 36.9±9.6% of control, respectively) but not different for M and F for EE (29.1±10.1% of control). For EF and EE, there was a main effect of time on CMEP area but no effect of sex. Post-hoc tests revealed the CMEP was larger than control at 15s of fatigue for EF and EE and was smaller than control from 75s onward for EE. There was an effect of muscle and time, but not sex, for VA in recovery. VA was impaired post-fatigue in EFs (83.3±17.6% at 15s) but not EEs (93.2±9.3% at 15s).
Discussion
These data suggest that M and F have an equivalent ability to drive their muscles after a sustained 2min MVC of the EF or EE. Moreover, despite the possibility of greater group III/IV afferent activity in M due to greater glycolytic activity (Russ et al. 2005), the impact of fatigue on motoneuron responsiveness was not different between M and F for either muscle group.
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Contact
chris.mcneil@ubc.ca

INCREASED VASTUS LATERALIS' HARDNESS AFTER 15 WEEKS OF RESISTANCE TRAINING: AN ULTRASOUND STRAIN ELASTOGRAPHY STUDY

ARMADA, P.

FACULTY OF HUMAN KINETICS

Introduction
Muscle hardness can be defined as the resistance offered by muscle tissue to compression. Ultrasound strain elastography (USE) allows non-invasive and semi-quantitative evaluation of muscle hardness. Here we employed USE to measure vastus lateralis hardness before and after resistance training.
Methods

Twenty-eight males (mean age 20±3.3 yrs) were assigned to one of three groups: control group (n=8), concentric training group (n=8), and eccentric training group (n=9). Resistance exercise was performed three times per week for 15 weeks on an isokinetic dynamometer (System 3, Biodex Medical Systems). Knee muscle contractions were performed with each leg at an initial velocity of 60 degrees/s that increased along the weeks up to 180 degrees/s. Ultrasound scans (HITACHI EUB 7500, HITACHI Medical Corporation, Tokyo, Japan) were collected from the vastus lateralis with the linear probe (7-12 MHz) parallel to muscle fascicles. The fraction of red, green, and blue pixels within a given region of interest were measured with a routine MATLAB (The MathWorks, Inc., Natick, Massachusetts, USA). Mixed two-way ANOVA was used to assess statistical significance.
Results
After training, knee extensors strength increased in both training groups [$F(1,18) = 58.583$; $p<0.001$]. After training the fraction of red pixels decreased ($p<0.001$) and that of the harder green and blue pixels increased ($p<0.01$ and $p<0.05$ for green and blue pixels, respectively) with no differences between the training groups or between the legs.
Discussion
An increase in muscle tissue hardness after both concentric and eccentric resistance training was demonstrated in this study. Using shear-wave elastography, increased shear modulus of the triceps brachii was observed acutely after resistance exercise (1) but not after 6 weeks of resistance training. However, our resistance training was longer and more intense and these differences might justify the discrepant results. Increased passive stiffness of gastrocnemius muscle has been demonstrated after strength training (2) and a direct relationship exist between longitudinal muscle stiffness and axial hardness (3). In our study we could not find differences between concentric or eccentric type of resistance training suggesting that the two kinds of training produce similar changes in muscle hardness.
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EFFECT OF ELECTRODE POSITION FOR LOW NEUROMUSCULAR ELECTRICAL STIMULATION ON THE QUADRICEPS

WATANABE, K.
CHUKYO UNIVERSITY

Introduction
Neuromuscular electrical stimulation (NMES) has been used to prevent muscle atrophy and promote energy metabolism for clinical purposes (ex. Watanabe et al. 2014). Recently, this method has been widely developed as a strength training tool for the general public. However, very few studies have reported on the optimum conditions for commercially developed low-current intensity NMES devices. The present study aimed to test the effect of the electrode position and inter-electrode distance on the evoked force by NMES with a single pair of electrodes.
Methods
Isometric knee extensor forces during NMES to quadriceps femoris muscles were compared among four different electrode conditions in seven young men. Electrodes were located at 10 cm proximal and 15 cm distal (P10-D15), 10 cm proximal and 10 cm distal (P10-D10), 5 cm proximal and 15 cm distal, and 5 cm proximal and 10 cm distal (P5-D10) to the center of the longitudinal axis of the quadriceps femoris muscles. The stimulation protocol involved 20 sec of 2 Hz, 20 sec of 4 Hz, 10 sec of 8 Hz, and 10 sec of 16 Hz with the maximum current intensity of the device (50V and 4.85 mA). Evoked force-time area during stimulation was compared among the four different electrode conditions.
Results
The evoked force-time area was significantly changed with the electrode position ($p < 0.0001$, Friedmann test) and that for P5-D10 was significantly higher than those for P10-D15 and P10-D10 ($p < 0.05$, the Wilcoxon test with Bonferoni correction).
Discussion
The present study demonstrated that the evoked force during NMES with low-current intensity is influenced by the electrode position, and a closer inter-electrode distance induces a greater force. Recent study by Vieira et al. (2016) showed an increase in the electrode distance along the longitudinal axis of the quadriceps femoris muscles leads to a greater evoked force. While this previous study applied a 60 to 100mA current intensity, our device generated a 4.85mA current intensity. Since innervation zones for the quadriceps femoris muscles are regionally distributed along the muscle (Botter et al. 2011), the greater inter-electrode distance would stimulate a larger number of innervation zones when the current intensity is high enough to stimulate the innervation zone and/or muscle under and between electrodes. On the other hand, an increase in the inter-electrode distance would decrease the current density within the underlying tissue. Therefore, the greatest force was applied with a shorter inter-electrode distance for NMES with a low current intensity in the present study. Our study suggests that when NMES with a low current intensity (~4.85 mA) is applied to the quadriceps femoris muscles, a relatively shorter inter-electrode distance (15~20 cm) could induce a greater evoked force.
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MORPHOLOGICAL DETERMINANTS OF EXPLOSIVE STRENGTH

MADEN-WILKINSON, T.M., BALSHAW, T.G., MASSEY, G., FOLLAND, J.P.
SHEFFIELD HALLAM UNIVERSITY; LOUGHBOROUGH UNIVERSITY

Introduction
Whilst neural drive and contractile properties are well defined physiological determinants of explosive strength (Folland et al. 2014), the role of morphological variables in the production of explosive strength are poorly understood. The aim of this study was to examine the relationships between Quadriceps Femoris muscle volume (QFVOL), architecture (pennation angle [Ap] and fascicle length [FL]) and patellar tendon moment arm (PTMA) with voluntary and evoked explosive knee extension torque in young men.
Methods
53 recreationally-active men (25±2 yrs, 1.75±0.08 m, 71±10 kg) completed this study. Following familiarisation, maximum and explosive voluntary and evoked octet (8 pulses at 300-Hz) contractions were performed using a custom-built isometric knee-extension testing chair. Torque was measured at 50 ms increments (T50, T100, & T150) during explosive voluntary and evoked octet contractions, as well as

maximum voluntary (MVT). QFVOL and PTMA were quantified using 1.5 T MRI. B-mode ultrasound quantified Ap and FL at 2-3 sites for each constituent muscle, before averaging within each constituent muscle and then calculating a weighted QF mean.
Results
QFVOL had a progressively stronger relationship with explosive strength throughout voluntary explosive contractions (T100: r=0.495, p<0.001; T150: r=0.663, p<0.001), and was also related to evoked torque at all time points of the octet contractions (T50 and T100). PTMA was related to voluntary explosive torque at T150 (r=0.306, p<0.001), but not evoked octet torque (p>0.06). QF Ap was related to later phase voluntary explosive strength (T100, r=0.336, p=0.020; T150, r=0.356, p=0.013), and evoked octet torque (T50, r=0.300, p=0.038; T100, r=0.330, p=0.022). There was no relationship between FL and any of the voluntary or evoked explosive strength variables (all p>0.139). When explosive torque was expressed relative to MVT, there was no relationship with morphological or moment arm variables (all p>0.13). Stepwise linear regression explained no additional variance, beyond QFVOL, when incorporating PTMA and Ap for either voluntary or explosive T100 or T150.
Discussion
QFVOL, PTMA and AP were related to explosive voluntary and evoked octet torque especially in the later phases of contraction. When explosive strength was expressed relative to MVT, there was no longer any relationship with morphological or moment arm variables. Therefore it seems likely that these factors influence explosive torque via MVT, rather than as a direct/independent determinant.
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FORCE-VELOCITY PROFILES OF A LEG-EXTENDING MODEL MUSCLE FOR MALE ATHLETES IN THE THROWING EVENTS

SCHLEICHARDT, A., BADURA, M., UEBERSCHÄR, O., FICHTNER, I.

IAT LEIPZIG

Introduction
Strength capabilities of the legs play an important role in the athletic throwing events. On a limited path of acceleration, a high momentum must be transferred to the throwing device for maximizing the energy output. Any acceleration of the throwing device is supported by a corresponding activity of the legs. The aim of this study was to quantify the maximal power of a suitable leg-extending model muscle among national elite athletes (including world and Olympic champions and medalists) and to investigate its correlation to the throwing performance in the field.
Methods
The leg extending forces of 35 male athletes (20.2 ±3.8 yr; 101.7 ±17.6 kg; 1.91 ±0.09 m) of all athletic throwing events (i. e., shot put, discus, javelin and hammer) were measured on a leg press at four speeds. Employing a suitable model of the lower extremities, the acting forces and the corresponding contraction velocities of a leg-extending model muscle were computed for each athlete (Siebert et al., 2007). By means of Hill's law (Hill, 1938), the maximal power and the optimal contraction velocity of the muscle could be quantified. Furthermore, the individually achieved device release speeds were measured in a field test.
Results
For shot put, discus, javelin and hammer the maximal powers (we obtained the median for "typical" athletes) were 1445, 858, 963 and 1730 W, respectively. The associated optimal contraction velocities were 1.29, 0.61, 0.51 and 0.70 m/s, whereas the release momenta amounted to 89, 43, 19, 182 N s.
Discussion
Our results for maximal power compare to those in literature (Zupan et al., 2009) with a tendency to the higher values reported there. However, the high power values for the shot putters and hammer throwers are rather surprising. Studying the relation between maximum power and the device's release momentum for each event, we find an intriguing, strong correlation (r = 0.94). Regarding the power-velocity relations, the high optimal contraction velocities of the shot putters are remarkable. In this respect, the shot put seems to be the event with the highest speed reference, possessing a flat force-velocity profile with high forces at high contraction velocities.
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Contact
schleichardt@iat.uni-leipzig.de

Conventional Print Poster

CP-PM04 Training and performance in team sports

EFFECTS OF A PRE-SEASON PREPARATION ON ANTHROPOMETRIC AND PHYSICAL CAPACITIES IN A TOP-LEVEL MALE GERMAN HANDBALL TEAM

BROCHHAGEN, J.1, BAUMGART, C.1, HINZE, S.2, GRÖGER, D.2, FREIWALD, J.1, HOPPE, M.W.1

1: UNIVERSITY OF WUPPERTAL, 2: BHC, WUPPERTAL

Introduction
To optimize the physical performance of a competitive handball team during the season, it is expected to accomplish a pre-season preparation to increase anthropometric and physical requirements (Wagner et al., 2014). However, this topic is not examined in players competing on an European top-level. Therefore, this study investigated the effects of a pre-season preparation on anthropometric characteristics and physical capacities in an European top-level male handball team.
Methods
Twelve male team-handball players competing in the German Bundesliga participated. The sample included eight national players. All players were tested before and after a pre-season preparation, lasting six weeks, for anthropometric characteristics (body mass, fat and

fat-free mass), speed (5, 10, 20 and 30 m), agility (22 m), vertical jump height (squat, counter movement and handball- specific jump), aerobic endurance (time to exhaustion, maximum oxygen uptake and time to reach a respiratory exchange ratio of 1) and intermittent endurance (interval shuttle run test performance and submaximal heart rate). From a physical point of view, the preparation period focused on small-side games as well as resistance, sprint and plyometric based training. All training sessions were instructed by the professional coaches of the team. For statistical analyses effect sizes (ES) and magnitude based inferences for practical significance were computed.
Results
The changes in anthropometric characteristics along with those in aerobic endurance were unclear to likely trivial (trivial to small ES). For speed, agility and vertical jump height unclear changes were found (trivial to small ES). However, the changes in intermittent endurance were most likely (large to very large ES).
Discussion
For the first time, our findings show that a pre-season preparation did not impact important anthropometric characteristics along with aerobic endurance, speed, agility and vertical jump height of a male top-level handball team. Contrary, there was a large improvement in the intermittent endurance. The finding may be caused by the high initial level of our players, genetically different determined abilities to adapt and the particular contents of the preparation period (Bompa and Haff, 2009). Although our findings allow no generalization due to the applied case study design, they should be considered when planning a pre-season preparation of an European top-level handball team.
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Contact
joana.brochhagen@uni-wuppertal.de

THE INFLUENCE OF VOLLEYBALL SPECIFIC REPEATED JUMPS ON LOWER BODY NEUROMUSCULAR FUNCTION AND BILATERAL ASYMMETRY

MCMANUS, C., MURRAY, K., JANTEA, A.
THE UNIVERSITY OF ESSEX

Introduction
Volleyball is a highly asymmetric sport; particularly the approach and foot-plant phases of the spike jump. Repetition of asymmetrical movements may exacerbate the degree of bilateral asymmetry displayed in athletes, increasing the potential for musculoskeletal injury. Asymmetries of 15% or greater may warrant closer attention, acting as an asymmetry threshold predictive of injury (Hewit et al., 2012). The aim of this study was to examine the magnitude of change in vertical jump performance following a volleyball specific, spike jump protocol, with specific reference to changes in bilateral asymmetry.
Methods: Nine male university volleyball players participated in this study. Countermovement jump (CMJ) performance was assessed before, immediately post (0 hr), 1 and 24 hours after a fatiguing protocol of 10 x 10 volleyball spike jumps. The CMJ protocol consisted of five maximal efforts on a dual-force platform. Each trial was analysed from the vertical ground reaction force (vGRF). Mean jump height (JH), concentric (CON) and eccentric force (ECC) were determined as the sum of both legs. To determine asymmetry, asymmetry index (ASI) was calculated as [(dominant - non-dominant)/dominant] x 100. ASI variables include CON-ASI, ECC-ASI and concentric peak force (CPF-ASI). The interday coefficient of variation (CV) was calculated from the baseline data and meaningful differences in CMJ performance were examined through effect sizes (ES) and comparisons to interday CV.
Results
All CMJ and asymmetry variables exhibited inter-day CVs of <5%. At 0 hr, moderate ES were observed in JH (ES=0.6) and CPF-ASI (ES=0.7), showing changes greater than the CV in most individuals. At 1 hr post-fatigue, trivial and small changes were observed for all but CON-ASI, where a moderate ES (ES=0.5) showed a shift towards greater force production from the dominant leg compared with baseline. At 24 hr post, a small ES (ES=0.4) showed CON continuing to decline from baseline, with mean changes greater than the CV.
Discussion
The present study found that 100 repeated spike jumps adversely affects JH immediately post exercise (-9.7%; 90% CI = -4.9, -14.6%) and remains impaired 24 hrs later (-5.0%; 90% CI = -1.1, -8.9%). Despite a reduction in JH, and moderate ES changes in CON-ASI and CPF-ASI in the 0 - 1 hours following fatiguing exercise, change in ASI variables was less than 5%. These results suggest that neuromuscular fatigue, induced via asymmetrical spike jumping, is unlikely to further increase the risk of injury via altered bilateral asymmetry in individuals who possess baseline ASI values that are ≤10%. However, individuals with ASI values of >10% at baseline may be advised to minimize imbalances as much as practically possible. Furthermore, it appears that the individual response to repeated spike jumping varies greatly and warrants further examination, particularly following on-court practice and match-play.
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PERFORMANCE OF FEMALE RINK HOCKEY PLAYERS

STEPHAN, H., CHROBAK, S., HERZIG, M.L., HAGEDORN, T., HILBERG, T.
UNIVERSITY OF WUPPERTAL

Introduction
Rink hockey is a team sport with intervals of different intensities which is, however, represented with a minor number in the written English scientific literature only. The purpose of this examination was to describe the performance capability of female rink hockey players in order to enhance the understanding of its peculiarities and to improve training scheduling.
Methods
The endurance (cycle ergometer), strength (isokinetic device), functional movement (FMS) as well as sprint and jump abilities (light barriers) were investigated in 12 female roller hockey players of an extended German Bundesliga team.
Results
The mean aerobic capability was estimated with 38.6±6.1 ml•kg-1•min-1 via the reached power of 2.86±0.51 W/kg. The average isokinetic strength was balanced between the legs and about twice as high for the extensors (right 2.0 and left 1.9 Nm/kg) in comparison to the flexors (1.0 Nm/kg for both legs). The average sprint times were slower for those trials with skates in comparison to trials with shoes

on 5 m, 5-20 m and 20 m (1.40 vs. 1.39 s / 2.52 vs. 2.47 s / 3.92 vs. 3.86 s). The jumping tasks resulted in similar average heights (counter movement jump 28.3 cm vs. drop jump 28.0 cm). The Functional Movement Screen resulted in an average score of 16.2.
Discussion
The results of the present study reveal inhomogeneous performances and suggest improvable endurance, demands in some functional movements, reduced sprint ability and conspicuous differences in leg strength in some cases. The hamstrings to quadriceps torque ratio can be compared to different sports, nevertheless a higher ratio might decrease injury risks. Although the relative torque appears to be at least not lower than depicted in the literature, the calculated difference to men is supposed to be slightly elevated. The jump ability of female rink hockey players is similar to other active females. The current study presents for the first time an overview of physical fitness in female rink hockey players. Especially endurance and sprint performance should be enhanced. Further studies are needed to determine the demands as well as performance limiting parameters in female rink hockey players.
Contact
hstephan@uni-wuppertal.de

EFFECT OF ADDITIONAL CONCURRENT SPECIFIC STRENGTH AND REPEATED SPRINT TRAINING DURING PRESEASON ON PERFORMANCE IN FUTSAL PLAYERS

PHONGSRI, K.1, TONGNILLPANT, N.2, AJJIMAPORN, A.3, SILALERTDETKUL, S.1
1: SP-SWU (NAKHON NAYOK, THAILAND), 2: SAT (BANGKOK, THAILAND), 3: SS-MU (NAKHON PATHOM, THAILAND)

Introduction
Combining mode of exercise training including strength, power, and repeated sprint ability (RSA) may be an effective way for improve sport performance. However, the long term effect of concurrent strength and endurance training is still unclear. Therefore, the objective of this study was to examine whether supplementing concurrent specific strength and repeated sprint training during preseason would have the effects on futsal performance.
Methods
Fourteen male futsal players (Age, 20 ± 1 years; Weight, 62 ± 7 kg; VO2 max, 51.8 ± 6 ml/kg/min: mean ±SD) were divided randomly assigned to either a normal futsal training group (NTG, n = 7) or a concurrent training group (CTG, n = 7) for five weeks. NTG performed normal futsal training (physical fitness, technical, and tactical training). CTG receiving additional specific strength (3 strength exercises x 2 sets at 70% 1-RM with 5 vertical jumps over hurdles (40 cm), each set separated by 3 mins rest) and repeated sprint (7 x 2 sets of 30 meters maximal shuttle sprints, set separated by 5 mins rest) training supplementing regular preseason futsal training with twice per week for 5 weeks. RSA test, body composition, 1RM (repetition maximum), squat (SJ) and countermovement jumps (CMJ), agility t-test, VO2max, 20-meters sprint, and Yo-Yo intermittent recovery test level 1 (YoYo IR1) were assessed before and after training.
Results
After the preseason training, mean RSA time in CTG was significantly faster than NTG (CTG, before: 7.4 ± 0.1 s; after: 7.3 ± 0.1 s vs. NTG, before: 7.5 ± 0.2 s; after: 7.6 ± 0.2 s, $p < 0.05$). 1RM of barbell squat, 1RM of standing barbell calf raise, and YoYo IR1 were significantly improved for both groups ($p < 0.05$). There were no changes in body composition, VO2max, 1RM of lying leg curl, SJ, CMJ, 20-meters sprint times, agility t-test time, and RSA decrement in both groups.
Discussion
Additional concurrent specific strength and repeated sprint training protocol in this study can be an effective training strategy for induced futsal specific performance especially RSA. Previous studies reported that RSA was improved following concurrent training in team sport players (Buchheit et al., 2010; Wong et al., 2010). The findings suggest that specific strength training can be concurrently performed with repeated sprint training to enhance futsal performance.
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Contact
bombswu@yahoo.com

AGE RELATED AND TRAINING INDUCED CHANGES IN SOMATOTYPE COMPONENTS OF YOUTH ELITE MALE SOCCER PLAYERS

ANDROULAKIS, N., KOUNDOURAKIS, N., PLESITIS, V., NOTAS, G.
ERGOTELIS F.C.

Introduction
In soccer, morphological characteristics of young players are very important as they have a significant impact on the performance of all technical-tactical elements. Our aim in this study was to investigate whether soccer specific training alone or combined with strength training can influence somatotype components, in young soccer players and if so, to establish which age is more appropriate for interventions through individualized training.
Methods
The study population consisted of 61 male young soccer players, members of two under 17 (U171: n= 17, mean age: 15.9±0.6 years and U172: n= 18, mean age 16±0.4 years) and two under 20 (U201: n=14, mean age 18.3±0.9 years and U202: n=12, mean age 18.1±0.5 years) teams. During both pre-season and competition periods, players participated in approximately 280 training sessions of 75-95 minutes' duration, focusing on all aspects of physical conditioning and technical-tactical elements of the game. The main difference between teams U171 and U201 with teams U172 and U202 consisted in the number of the strength based training sessions. Particularly, players of U171 and U201 performed only general strength-circuit training sessions while those of teams U172 and U202 performed an extra "pyramid" strength training session every week, which in U171 and U201 teams was replaced with an aerobic training session.
Anthropometric measurements were performed at the beginning and at the end of the season.
Results
As expected, players of U171 and U172 teams were found taller (1%, 1.1% respectively), heavier (2.6%, 3.6% respectively) and with increased (2.4%, 3.6% respectively) lean body mass (LBM) at the end of the experimental period. The players of U201 team had significantly higher LBM (3.3%) at the end of the examined period compared to baseline. LBM also increased by 3.9% in the U202 team but this result was not significant. Regarding somatotype components, no significant changes were found in teams U171, U201 and U202 at the end of

the experimental period compared to baseline. However, players of the U172 team displayed significantly increased mesomorphy score from 3.9 ± 0.7 to 4.3 ± 0.6 (9.8% increase) but no significant changes in endomorphy and ectomorphy scores
Discussion
Our data supports that ages between 15-17 years are most appropriate for individual interventions in training routine in order to achieve anatomical and morphological characteristics most favorable for soccer.
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Contact
nikandgr@gmail.com

CHANGES IN BODY COMPOSITION AND PERFORMANCE IN ADOLESCENT AMERICAN FOOTBALL PLAYERS FOLLOWING THREE WEEKS OF DETRAINING

GAVANDA, S., KANTAREV, A., BRINKMANN, C., GEISLER, S.
IST UNIVERSITY OF APPLIED SCIENCES

Introduction
Because studies of detraining in adolescent athletes are rare and often inconsistent, the aim of this study was to measure changes in body composition and performance in trained adolescent American football players following three weeks of detraining.
Methods
Twelve adolescent male athletes (age: 17 ± 1 years, height: 186 ± 6 cm) participated in a twelve-week weight training program, followed by a three-week detraining period. Maximal strength (squat and bench press), counter movement jump height, medicine-ball throw distance, 40 yard dash time, body composition (BIA) and muscle thickness of the M. rectus femoris, M. vastus lateralis and M. triceps brachii (using ultrasound) were measured right before and after the detraining period.
Results
There were significant changes in the M. rectus femoris muscle thickness ($p < 0.05$). Maximal strength, counter movement jump height, medicine-ball throw distance, 40 yard sprint time, overall body composition and muscle thickness of the M. vastus lateralis and M. triceps brachii did not change.
Discussion
A three-week detraining period does not lead to significant reductions in muscle mass or performance. The loss of the M. rectus femoris muscle thickness could have been within measurement errors, because overall muscle mass did not change.

INFRASPINATUS MUSCLE THICKNESS BILATERAL DIFFERENCE IN BASEBALL PITCHERS AND OTHER ATHLETES

TANIMOTO, M., NAGATOMO, A., GESHIRO, S., ARAKAWA, H.
KINKI UNIVERSITY

Introduction
Rotator cuff is believed to have the function of maintaining the stability of the shoulder joint. A baseball pitcher doing shoulder movement with a large range of motion, velocity and moment may need potent shoulder joint stability. The baseball pitcher's rotator cuff may hypertrophy due to the pitching movement stimulus. We measured the infraspinatus muscle thickness of baseball pitchers and other athletes, and compared the dominant and non-dominant sides. The infraspinatus muscle is part of the rotator cuff.
Methods
15 baseball pitchers, 13 baseball fielders, 11 volleyball players not included setter or libero, 13 Judo players and a control group of 11 men without exercise habits participated in this study. We measured the muscle thickness of their dominant and non-dominant side infraspinatus muscle, greater pectoral muscle and latissimus dorsi muscle using an ultrasonic imaging devise. The muscle thickness of the infraspinatus muscle was measured at the muscle belly with shoulder joint 90-degree abduction and 90-degree external rotation position. The muscle thickness of the greater pectoral muscle and latissimus dorsi muscle were measured as representative muscle of shoulder movement.
Results
In baseball pitchers, the muscle thickness of the infraspinatus muscle was 20.8±2.5mm in the dominant side and 20.6±2.3mm in the non-dominant side. There were no significant differences between the dominant and the non-dominant side. The muscle thickness of the dominant side latissimus dorsi muscle was significantly larger than the non-dominant side (32.6±4.7mm vs 27.2±5.6mm). Almost identical tendencies were observed in the baseball fielders and the volleyball players. The Judo players had no muscle thickness bilateral differences in the three observed muscles and had significantly larger muscle thickness than the other groups in the three muscles. In the non-exercise habits control group, the muscle thickness of the dominant side infraspinatus muscle was significantly larger than the non-dominant side (21.1±3.1mm vs 19.3±2.1mm). There were no significant differences between dominant and non-dominant side in the greater pectoral muscle and the latissimus dorsi muscle.
Discussion
In baseball pitchers, the infraspinatus muscle thickness was not larger in the dominant side than in the non-dominant side, and was almost the same as in the non-exercise habits control group.
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Conventional Print Poster

CP-BN05 Kinematic analyses in biomechanics

STUDY OF SPRINT-ASSISTED TRAINING FOR SWIMMERS

TANAKA, T., YOSHIMURA, Y., YASUKAWA, M.
CHUO UNIVERSITY

Introduction
One of the training methods available for swimmers is sprint-assisted training, which is commonly used to improve the swimmer's ability to apply force over a greater distance. However, the influence on stroke techniques caused by a change in the assist velocity is unknown. The purpose was to investigate the effects of changes in the assist velocity on butterfly swimmers' stroke techniques for each stroke phase.
Methods
This study evaluated one male Japanese competitive collegiate butterfly swimmer. The study used a pulling assist system (PAS) with a velocity meter. The system recorded the intracyclic velocity variations over 25 m for which maximum effort was employed, with assisted mean velocities of 0.0 m/s (baseline) and 2.0 m/s (assisted speed [AS] 1). Based on the video analysis system, the authors divided the stroke cycle into four phases: Phase 1) first kick, Phase 2) insweep, Phase 3) upsweep and a second kick, and Phase 4) wave. The distance per phase (DPP) and pitch were determined for each stroke phase for the subject. For the whole stroke, mean pitch and mean DPP were compared between baseline and AS1 using t-test. And for each stroke phases, they were compared using Bonferroni-type multiple testing procedures (significance level is 0.0125).
Results
While no statistical differences in pitch were observed between the baseline and AS1 for one stroke (1.13 ± 0.04 sec vs. 1.16 ± 0.02 sec, $p = 0.151$), there is a statistical difference in the DPP (1.89 ± 0.04 m vs. 2.37 ± 0.03 m, $p < .001$). That is, the pitch did not change when the subject swam using the PAS in comparison with the baseline, although the DPP increased. Additionally, when analyzing one stroke in every phase, the pitch of AS1 was faster than that of the baseline for Phase 1) [0.34 ± 0.03 sec vs. 0.24 ± 0.02 sec, $p < .001$], but was slower than that of the baseline in Phase 3) [0.20 ± 0.06 sec vs. 0.38 ± 0.02 sec, $p < .001$]. The DPP for AS1 was smaller than that of the baseline in Phase 1) [0.59 ± 0.03 m vs. 0.45 ± 0.03 m, $p < .001$], but was larger than that of the baseline in Phase 3) [0.38 ± 0.09 m vs. 0.90 ± 0.04 m, $p < .001$]. In addition, although the PAS was used, there was no significant difference in the DPP in Phase 2) [0.25 ± 0.03 m vs. 0.32 ± 0.05 m, $p = 0.029$] and Phase 4) [0.68 ± 0.07 m vs. 0.71 ± 0.04 m, $p = 0.317$].
Discussion
These findings will lead to understanding of more efficient stroke patterns for competitive swimmers.

THE INFLUENCE DEGREE OF RELEASE PARAMETERS ON BALL ARRIVAL POSITION IN BASKETBALL SHOOTING

NAKANO, N., FUKASHIRO, S., YOSHIOKA, S.
THE UNIVERSITY OF TOKYO

Introduction
The basketball shot is determined by the release parameters such as the position, angle, and speed of the ball at release. In order to reduce the variability, it is important how the change of each release parameter affects the ball arrival position. Therefore, the aim of this study was to clarify the influence degree of each release parameter on the ball arrival position in basketball shooting.
Methods
10 male basketball players made 3 successful shots at each three distances (short, mid, and long). A motion capture system was used to record the coordinates of the reflective markers attached on the ball at 200 Hz. From the equation of motion for a ball in a two-dimensional plane, the estimated arrival position at the height of the ring (3.05 m) was expressed as a function of the release parameters. By partially differentiating the function with each release parameter, the variation of the arrival position when each release parameter changed by 1% was calculated and it was defined as the influence degree of each release parameter.
Results
The influence degree of each release parameter to the arrival position at 3 distances (short, mid, and long, respectively) were 9.2,11.7,14.2 cm in release speed, -2.9, -3.5, -4.0 cm in release angle, 1.4, 1.4, 1.4 cm in vertical position, and 0.7, 0.8, 0.9 cm in horizontal position. When the absolute values were compared between the parameters, they were significantly greater in the order of the release speed, the release angle, the vertical position, and the horizontal position ($p<0.01$). This trend was common under all distance conditions.
Discussion
An arrival position is determined by a combination of four release parameters. Kudo et al. (2000) showed that release parameters were complementarily coordinated with one another to reduce the variability of the arrival positions in underarm ball throwing, but it is considered difficult to coordinately control four parameters equivalently. Because there is a margin of error due to the difference in diameter between the ball and the ring (Bartlett et al., 2007), the influence degree of release positions is so small that the change of several percent of release positions is allowed. Therefore, the variability of the arrival position may be reduced mainly by complementary coordination between the release speed and the release angle. Since the influence degree of the release speed is especially large, it is suggested that the release angles are coordinated in order to compensate for the variability of release speed in shooting.
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Contact
nakano-nobuyasu@g.ecc.u-tokyo.ac.jp

THE ANALYSIS OF MECHANISM TO INCREASE ENERGY OF PELVIS IN BASEBALL PITCHING

ARATA, K., SHINSUKE, Y., SENSHI, F.
THE UNIVERSITY OF TOKYO

Introduction

In baseball pitching, pelvis rotational velocity increases as ball velocity grows up (Stodden et al., 2001). Therefore, it is important to increase the energy of the pelvis to grow up ball velocity. However, the mechanism to increase the energy of pelvis has not been examined. The purpose of this study was to investigate the mechanism to increase the energy of the pelvis in baseball pitching.
Methods
Twelve baseball players participated in this study. We instructed the participants to throw a straight ball with the right (dominant) hand aiming at a target. The horizontal distance between the target and the marker line at which the participants readied themselves was 5 m. Reflective markers attached to each player and a ball were collected with a motion capture system. Ground reaction force data of both legs were collected with two force platforms. We calculated joint torque power and segment torque power in the both hip joint and pelvis by an inverse dynamics (Robertson and Winter, 1980). The joint torque power and the segment torque power were integrated by the time to find the amount of energy generation, absorption and transfer by the joint torque.
Results
In the pivot (right) leg, the energy of the pelvis was increased due to energy generation by hip extension and hip adduction torque and energy transfer by hip external rotation torque. Concerning the stride (left) leg, the energy of the pelvis was increased due to energy generation by hip adduction torque
Discussion
We demonstrated that hip extension and hip adduction torque of the pivot leg and hip adduction torque of the stride leg generated the energy. The adductor of the hip muscles of both lower limbs were strongly contracted from the ground contact of the stride leg to ball release (Yamanouchi, 1998). In addition, gluteus maximus activity of the pivot leg was observed to be in excess of 100 % of maximum voluntary isometric contraction (Oliver et al., 2010). These results support the finding of this study.
The energy was transferred from the thigh of the pivot leg to the pelvis owing to both pelvis and thigh rotation in the pitching direction and hip external rotation torque of the acting pivot leg. Therefore, it is considered that external rotation torque of the pivot leg transfers the energy generated at the knee and the ankle to the pelvis.
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KINEMATIC ANALYSIS OF BASEBALL PITCHING MOTION WITH THE DIFFERENT RANGES OF MOTION IN NON-PITCHING ARM JOINTS

UEDA, A.,1,2 MATSUMURA, A.1, OKI, T.3, TAKEI, S.3, NAKAMURA, Y.1
1.DOSHISHA UNIVERSITY, 2,3.HANKAI HOSPITAL

Introduction
Previous studies have investigated baseball pitching arm motion, but there are few reports on non-pitching arm motion. In a previous study that investigated the effect of the non-pitching arm (Ishida et al, 2004), the entire arm was fixed to the trunk with belts. Therefore, the influence of each joint in the non-pitching arm was not clarified. The purpose of this study was to investigate the effects of non-pitching shoulder and elbow motion on pitching.
Methods
Subjects included 13 healthy baseball players (age 19.8 ± 2.2 years). Pitching motions were examined using a motion capture system. Pitchers threw a ball under three conditions: unrestricted joint motion (normal group) and partially restricted shoulder and elbow joint motion in the non-pitching arm (shoulder fixed group, elbow fixed group). Peak kinematic parameters were calculated from stride foot plant period (FP) to ball release (BR).
Results
Ball velocities for the normal, elbow fixed, and shoulder fixed groups were 31.1 m/s, 30.4 m/s, and 29.2 m/s, respectively. The following results were observed in the shoulder fixed group. During the FP, shoulder abduction in the non-pitching arm was significantly less than in the other groups, and trunk rotation toward the throwing side was significantly less than in the normal group. Shoulder adduction in the non-pitching arm was significantly less than in the normal group at BR. During the period from FP to BR, the peak trunk rotation angular velocity toward the non-pitching arm was significantly smaller than in the other groups.
Discussion
The shoulder fixed group showed decreased range of shoulder abduction/adduction in the non-pitching arm from FP to BR. These results suggest that the rapid decrease in the moment of inertia relative to trunk rotation was restrained in the shoulder fixed group. Therefore, the angular velocity of trunk rotation was not increased by the limited decrease in the moment of inertia, due to the conservation of angular momentum. As a result, it is thought that the decrease in trunk rotation angular velocity after FP caused a decrease in ball velocity.
This study suggested that limited motion in the shoulder joint in the non-pitching arm causes reduction in ball velocity and trunk rotation.
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Contact
dhq0006@mail4.doshisha.ac.jp

DIFFERENCES BETWEEEN MOTION ANALYSIS SYSTEMS IN CALCULATING KNEE ANGLE IN ELITE RACE WALKING

HANLEY, B., TUCKER, C.B., BISSAS, A.
LEEDS BECKETT UNIVERSITY

Introduction
Race walking is an event dictated by a rule that states that no visible loss of contact with the ground should occur and that the leg must be straightened from first contact with the ground until the 'vertical upright position' (IAAF Rule 230.2). During competition, compliance with the rule is assessed subjectively by judges but during biomechanical testing it is important to measure the knee angle objectively and accurately. The aim of this study was to compare the measurement of knee angles between 2D video and 3D optoelectronic systems during race walking.
Methods

Seven elite male race walkers (stature: 1.77 m (± 0.03), mass: 65.7 kg (± 6.2)) and six elite female race walkers (stature: 1.66 m (± 0.08), mass: 58.6 kg (± 9.1)) participated in the study; in total, eight had competed at the Olympic Games. 2D video data were collected at 100 Hz using a high-speed camera. A 12-camera 3D optoelectronic motion capture system (Qualisys) operating at 250 Hz simultaneously captured the motion of three lower leg markers. The video files were digitised in two ways: first, through manually digitising by a single experienced operator; and second, using SIMI Motion's automatic tracking function to track the three retroreflective markers. The optoelectronic files were processed through Qualisys Track Manager. All sets of knee angle data were filtered using residual analysis and interpolated to 101 points using a cubic spline. The root mean square difference (RMSD) between conditions was calculated for each individual, averaged across their five trials, and then averaged across all participants.
Results
The RMSD between the two visual digitising methods for one gait cycle was 3° (± 1). The RMSD between manual digitising and Qualisys was 4° (± 1), whereas between automatic tracking and Qualisys it was 2° (± 1). At initial contact, the mean angle calculated using manual digitising was 181° (± 2), using automatic tracking 180° (± 4), and using Qualisys 180° (± 4). The maximum angle during midstance was 185° (± 4) using manual digitising, 183° (± 5) using tracking, and 183° (± 5) using Qualisys. The minimum angle during midswing was 100° (± 6) using manual digitising, 102° (± 5) using tracking, and 101° (± 5) using Qualisys.
Discussion
Overall, all three methodologies gave similar results with no difference greater than 2° at any discrete gait event. It was unsurprising that the automatic tracking function in SIMI Motion and Qualisys produced similar knee angles given they used the same three joint markers, and showed that any movement of the athletes' lower limbs out of the sagittal plane had little effect on joint angle calculation. In practical terms, using a markerless, 2D video system gave similar results to using a 3D optoelectronic system, meaning that it is appropriate for analysing in competition.

CORRELATION OF PADDLING POWER OUTPUT WITH KINEMATICS IN ELITE ABLE-BODIED FLAT-WATER KAYAKERS AND ELITE PARA-KAYAKERS

BJERKEFORS, A.1,2,3, ROSÉN, J.S.1, TARASSOVA, O.1, ANTON ARNDT, A.1,4
1: THE SWEDISH SCHOOL OF SPORT AND HEALTH SCIENCES, 2: DEPARTMENT OF NEUROSCIENCE, KAROLINSKA INSTITUTE (SWE), 3: THE SWEDISH SPORTS CONFEDERATION, 4; CLINTEC, KAROLINSKA INSTITUTE (SWE)

Introduction
Trunk, pelvis and leg movement have been shown to be important for performance in sprint kayaking. Para-kayaking is a new Paralympic sport in which athletes with impairments affecting the trunk and/or legs compete in three classification groups. The purpose of this study was to identify how the impairments affect performance by examining a) differences between able-bodied athletes (AB) and three elite para-kayak athlete (PA) groups in three-dimensional (3D) joint range of motion (RoM) and b) which joint angles were correlated with power output in AB and PA during kayak ergometer paddling.
Methods
41 PK participated in the study. All athletes were classified and assigned a class (KL1, KL2 or KL3; KL1 athletes had the greatest activity limitation and KL3 athletes the least). Data from a reference group of 10 AB were used for comparison. The paddling test was performed on a kayak ergometer at an individual high intensity level. 3D kinematic data were recorded using a 12-camera optoelectronic system. Markers were placed on the athletes to construct a whole body kinematic model. Piezoelectric force transducers were used to continuously measure force. To provide velocity input for power calculations markers were attached on the transducers.
Results
There were significant differences in RoM between the AB and the three PA groups for the shoulders (flexion, abduction, rotation: ABPA) and legs (hip, knee, ankle flexion: AB>PA) during paddling. Furthermore, the para-athletes with greater physical impairment exhibited lower trunk and leg RoM compared to those with less impairment. Significant positive correlations were found for both males and females between power output and hip, knee and ankle flexion RoM, maximum trunk flexion angle and trunk and pelvis rotation RoM.
Discussion
The results showed that impairments affecting the trunk and legs have an impact on performance. Having an impairment which limits the possibility to sit with a slightly flexed trunk position and rotate the trunk and pelvis reduces the power output by minimising the ability to reach forward. A greater forward reach has previously been shown to be a factor that distinguishes high performance AB paddlers from low performance paddlers (1). An impact on performance was also seen in athletes with impairments affecting the hip, knee and/or ankle RoM. In athletes with leg amputation, the results suggest that it is advantageous to use a prosthesis to facilitate leg movement which enables trunk and pelvis rotation (2,3). The results of this study are important for assisting coaches and athletes in understanding how key kinematic and kinetic variables for para-kayaking performance vary between athletes from different classification groups.
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Contact
anna.bjerkefors@gih.se

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CP-PM06 Lifestyle, physical activity and health

EXCESSIVE PHYSICAL ACTIVITY AND MORTALITY RISK: A META-ANALYSIS

BLOND, K.1, RIED-LARSEN, M.1, BRINKLØV, C.1, GRØNTVED, A.2
COPENHAGEN UNIVERSITY HOSPITAL

Introduction
Health benefits of physical activity of the recommended level are well documented. However, a U-shaped relationship between physical activity and mortality risk has been proposed such that the health benefits of physical activity would be attenuated at some high amount

of physical activity (O'Keefe & Lavie, 2012). The aim of our meta-analysis was to study the relation between mortality and physical activity in quantities above the recommended level compared to the recommended level.
Methods
We systematically searched Embase and Pubmed. Studies were included if the participants were adults not belonging to a specific risk group. Random-effect meta-analyses were performed to generate pooled relative risks. In this abstract, we present categorical analyses with leisure time physical activity of >4,500 MET-minutes/week compared to a reference of 500-1,500 MET-minutes/week.
Results
Of 18,398 studies retrieved by our searches, we included 55 cohorts in our review. Eleven cohorts had a physical activity category of >4,500 MET-minutes/week (up to 9,150 MET-minutes). The hazard ratio (95% confidence interval) for the category of >4,500 MET-minutes compared with the reference of 500-1,500 MET-minutes was 0.85 (0.76 – 0.96) for all-cause mortality, 0.78 (0.56 - 1.08) for cancer mortality, 0.70 (0.46 - 1.00) for cardiovascular mortality and 0.68 (0.43 - 1.09) for coronary heart disease mortality.
Discussion
Our results showed lower all-cause mortality in the group of >4,500 MET-minutes per week suggesting this amount to be safe, at least compared to 500-1500 MET-minutes. Similarly, in a meta-analysis, the lower risk of five diseases associated with total physical activity was not attenuated by participating in >8000 MET-minutes per week (Kyu et al., 2016). However, in a study of 1.1 million women, the lower risk of cardiovascular diseases associated with physical activity was suggested to be attenuated by daily strenuous activity (Armstrong et al. 2015). The diverging evidence on the subject of physical activity exceeding the recommendations warrants further studies.
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CAN A PEDOMETER INTERVENTION REDUCE SEDENTARY BEHAVIOR IN OLDER ADULTS?

SWARTZ, A.1, CHO, C.1, WELCH, W.2, WIDLANSKY, W.3, STRATH, S.1

1UNIVERSITY OF WISCONSIN-MILWAUKEE, MILWAUKEE, WI; 2NORTHWESTERN UNIVERSITY, CHICAGO, IL; 3MEDICAL COLLEGE OF WISCONSIN, MILWAUKEE, WI.

Introduction
Physical activity (PA) interventions have been shown to increase PA in older adults, and sedentary behavior (SB) interventions have shown modest reductions in SB. However, because of the distinctiveness of these two behaviors, researchers have question the transferability of an efficacious PA intervention to reduce SB. Some research suggests that PA may result in less SB, but research is mixed and little research has addressed this question in older adults. The purpose of this study was to determine whether changes to PA behavior in response to a pedometer intervention would also have a positive influence on reducing SB in older adults.
Methods
120 older adults from two separate 12-week steps/day-target interventions were included in this pooled reanalysis. Inactive older adults were randomly assigned to a step/d intervention (STEP) or a control group (CON). The STEP intervention was designed to increase steps/d by 10% of baseline step values each week, up to a target of 10,000 steps/d. A Hip-worn accelerometer (Actigraph) was used to assess 7-day PA and SB pre- post. Random effects models with a random intercept were used to model sedentary and PA behaviors while controlling for potential confounding effects of age and gender. All analysis were performed using SAS 9.4 (Cary, NC).
Results
Results showed a significantly greater decrease in SB (63.3±8.3% to 60.5±8.5% of wear time) and a significantly greater increase in moderate PA (2.4±1.5% to 4.4±3.1% of wear time) for the STEP group compared with CON (SB: 67.0±7.5% to 67.4±9.8% of wear time; moderate PA: 2.1±1.4% to 1.9±1.3% of wear time). At baseline, the participants in the CON group spent 37.5 minutes in SB for every minute in moderate PA compared to the 34:1 ratio for the intervention group at baseline ($p = 0.1264$). After the 12-week intervention, the two groups followed significantly different trajectories ($p < .0001$), where the control group slightly increased their sedentary: moderate PA minute ratio to 38:1, and the 10K step group significantly reduced their ratio to 19:1.
Discussion
Results confirm that steps/day-targeted interventions are a meaningful method to achieve recommended levels of health enhancing PA and decrease time in SB. The increased activity was largely a result of increased moderate intensity PA (+17.3 minutes) and decreased SB (-24.2 minutes). Results of this study support previous research that hypothesized increased PA may reduce SB through a substitution of time (1).
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PHYSICAL ACTIVITY IN WORKPLACE-SETTINGS: PRELIMINARY RESULTS OF TRISEARCH

RUDOLF, K.1, GRIEBEN, C.1, SCHALLER, A.1,2, PFÖRTNER, T.K.3, BIALLAS, B.1, STOCK, S.4, PFAFF, H.3, FROBÖSE, I.1

1: GERMAN SPORT UNIVERSITY COLOGNE, GERMANY; 2: IST UNIVERSITY OF APPLIED SCIENCES, DUESSELDORF, GERMANY; 3-4: UNIVERSITY OF COLOGNE, GERMANY

Introduction
Regular physical activity is one of the keystones in chronic disease prevention whereas increased sedentary time is associated with higher risk of premature all-cause and cardiovascular disease mortality (Lee et al., 2012). The cross-cutting issue 'physical activity' implements the topic of physical activity in the different subprojects within the research association TRISEARCH. The aim of this study is the comparison of physical activity and sedentary behaviour in the target groups of the subprojects (apprentices (APP), employees with health risk factors (EMP), and higher management staff (HMS)).
Methods
Accelerometer-data (Actigraph GT3X+) on physical activity and sedentary behaviour were recorded over seven days at baseline of three subprojects targeting health promotion in the workplace. In total, 22 APP (18.2 % male, mean age: 22.1 ±5.8 years, mean BMI: 23.4 ±3.8 kg/m²), 33 EMP (45.5 % male, mean age: 47.7 ±9.8 years, mean BMI: 30.1 ±5.9 kg/m²), and 25 HMS (72.0 % male, mean age: 50.4 ±5.8 years, mean BMI: 24.7 ±2.8 kg/m²) participated. Differences between groups were assessed using t-test and Mann-Whitney-U test.
Results

Seven participants (28%) of HMS, seven (21.2%) of EMP and four (18.2%) of APP comply with the WHO global recommendations on physical activity for health (WHO, 2010). HMS show highest duration of sedentary behavior per day (615.4 ±43.3 min/day), significantly more than EMP (557.4 ±89.7 min/day; p=0.007). EMP (1.8 ±3.2 min/day) obtain significantly lower physical activity of vigorous intensity than APP (3.3 ±4.5 min/day; p=0.045), and HMS (4.6 ±6.9 min/day; p=0.048). No significant differences between the groups were found regarding daily step counts and moderate-to-vigorous physical activity (MVPA) per day (all p>0.05).
Discussion
HMS, EMP and APP show comparable physical activity behavior. Although, only a minority of the different target groups complies with global recommendations on physical activity. Hence, health promotion targeting the enhancement of physical activity behavior seems advisable. Interventions should focus on reducing sitting time as well as increasing physical activity.
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BARRIERS TO HEALTHY LIFESTYLE IMPLEMENTATION AND CONDITIONS TO OVERCOME THEM FOR WOMEN IN FITNESS: CASE STUDY

CUPRIKA, A., FERNATE, A., CUPRIKS, L.

LATVIAN ACADEMY OF SPORT EDUCATION

Introduction
Despite the great popularity of fitness around the world, unhealthy behavior and habits are still becoming more common (WHO, 2016). That is why the goal of the study is to explore the barriers to a healthy lifestyle and the conditions to overcome them for women in fitness.
Methods
The study involved 16 women, who engaged in fitness in small groups for 6 months, lectures on a healthy lifestyle were organized additionally. In order to find the barriers and the conditions to overcome them, a semi-structured interview was applied. Coding of the data was carried out by applying QSRNVivo10 software. To compare samples, the Jaccard similarity coefficient was determined.
Results and Discussion
The barriers to a healthy lifestyle found during the fitness programme are surrounding people, who do not support; lack of health, knowledge and discipline; emotional instability; inability to concentrate. In the study healthy lifestyle is connected (SJ=1) to understanding of health, body and the need for physical activity; coach's knowledge; self-discipline and self-sufficiency. Furthermore, sedentary lifestyle is connected (SJ=1) to mood; psychological barriers; insecurity; other people's opinion; bad feelings from the past. As a result all these aspects were taken into account during the fitness programme. By analysing the conditions for overcoming barriers after the programme, it can be concluded that other participants of the group who motivated; the obtained knowledge and health; sense of responsibility and self-discipline helped to achieve the result. When implementing a healthy lifestyle, it is necessary to take into account each person's barriers and the possible conditions to overcome them.

THE ROLE OF PHYSICAL ACTIVITY IN THE ASSOCIATION OF SCREEN-BASED MEDIA USE AND HEALTH-RELATED QUALITY OF LIFE IN CHILDREN AND ADOLESCENTS

THOMANDL, L.1, POSTLER, T.1, HOFMANN, H.1, GRAF, C.2, OBERHOFFER, R.1, SCHULZ, T.1

1: CHAIR OF PREVENTIVE PEDIATRICS, TECHNICAL UNIVERSITY OF MUNICH; 2: INSTITUTE OF MOVEMENT AND NEUROSCIENCES, GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Health-related quality of life (HRQoL) is an important health outcome. In adulthood low levels of HRQoL increase the risk of hypertension, diabetes or cancer. Although studies show a negative impact of increased screen-based media use (SBM) on HRQoL in children and adolescents, the role of physical activity (PA) in this association is unclear. Thus, we examined the impact of physical activity on the relationship of SBM and HRQoL.
Methods
Data of 588 children and adolescents (51.5% male) aged 9 to 16 years was collected in 2015. PA was measured as the self-reported frequency of at least 60 minutes physical activity per day within a week. The daily time spent on SBM was collected using a score based on three questions (TV/videos, computer/Internet, gaming consoles) and HRQoL according to KINDL-R (scaled 0-100 points).
Results
35.5% had a daily SBM of ≤2h, 28.1% of >2h to ≤3h and 36.4% of >3h. 26.5% self-reported a PA of daily at least 60 minutes up to 3 days/week, 36.6% at 4-5 days and 36.9% at 6-7 days/week. The average of HRQoL was 73.3 (total), 75.0 (physical well-being), 82.1 (emotional well-being), 56.2 (self-esteem), 84.4 (family), 76.9 (friends) and 65.4 points (school). Compared to daily SBM of ≤2h and >2h to ≤3h, daily SBM of >3h was associated with lower total HRQoL (p=0.001) and school (p<0.001). Higher PA was associated with higher total HRQoL and all subscales except self-esteem. Within the subgroup of daily SBM of ≤2h, PA of daily at least 60 minutes at 6-7 weekdays has a positive impact on total HRQoL (+8.0 points, p<0.001) and subscale family (+10.4 points, p<0.001) compared to PA of daily at least 60 minutes at up to 3 days/week. The same effect was measured in the relationship of daily SBM >3h and total HRQoL (+7.6 points, p=0.001). In this subgroup, children and adolescents with PA of daily at least 60 minutes at 4-5 days/week and 6-7 days/week had an increased HRQoL in the subscale well-being compared to PA of daily at least 60 minutes at up to 3 weekdays (4-5 days/week: +9.8 points, p=0.004; 6-7 days/week: +9.7 points, p=0.004).
Discussion
PA positively modifies the association of SBM and HRQoL. Even if daily SBM is >3h, minimum 4-5 days of daily at least 60 minutes PA leads to higher total HRQoL and well-being in children and adolescents. As consequence, PA should be used as prevention strategy to increase HRQoL in children and adolescents with extensive SBM.

PHYSICAL AND PSYCHOLOGICAL EFFECTS OF LIGHT FOOT EXERCISE: A PILOT STUDY FOR AN EXERCISE SYSTEM TO IMPROVE PERFORMANCE OF ADL

HOSONO, M., INO, S.

NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY

Introduction

Exercise intensity is one of the most important elements that influence on adherence to physical activity (Lind et al., 2005). From the perspective that continuous performance of light-intensity exercise in a sitting position may help increase motivation for sedentary adults to improve activities of daily living (ADL) and adherence to physical activity, we are working on development of a foot exercise system. In this study, the physical and psychological effects of a foot dorsiflexion exercise in a sitting position were assessed to determine the potential of the light foot exercise.

Methods

Eight healthy adults participated in the foot exercise test. Their adherence to physical activity was classified in accordance with the transtheoretical model (Reed et al., 1997). The participants alternately dorsiflexed their right and left ankle joints 60 times at three different speed (once per 1, 2 or 4 s). Blood flow around the left knee and pulse rate were measured using a laser Doppler blood flow meter (RBF-101, Pioneer Co.). Perceived exertion and affective valence were assessed after each exercise using Borg's Rating of Perceived Exertion (RPE) Scale (Borg, 1982) and the Feeling Scale (FS) (Hardy and Rejeski, 1989), respectively.

Results

The participants were classified into two groups based on their exercise habits: regular exercise and no exercise. All participants experienced increased blood flow during the exercise, while the changes in pulse rate were moderate on average. The scores for the RPE scale were stable or increased as the speed became faster. However, the RPE scores showed interindividual variability and the FS scores demonstrated variable tendencies. Some members of both group showed negative FS ratings in the fastest or slowest exercise speed, while other participants showed stable, positive FS ratings for all speeds.

Discussion

The results showed that the intensity of the foot exercise was light, as the change in pulse rate, which is nearly equal to heart rate, is relatively small in all the participants. In contrast, perceived exertion and affective valence differed among the participants, regardless of their physical activity adherence level. Factors that influence affective valence need to be determined to enhance the flexibility of the exercise system for interindividual variability.

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A WEB PLATFORM TO PROMOTE HEALTHY BEHAVIOURS AMONG YOUNG ADULTS: USAGE DATA AND REASONS FOR NON-USAGE

STASSEN, G., GRIEBEN, C., FROBÖSE, I.

GERMAN SPORT UNIVERSITY COLOGNE

Introduction

Young adults are underrepresented in health promotion and need appropriate measures (WHO, 2010). Innovative eHealth- and mHealth-interventions are a promising approach to promote healthy behaviours (Nour et al., 2016). However, web-based interventions face recurring problems: small- or short-term effects, low usage and low adherence (Davies et al., 2012). The aim of the study was to analyse the usage of a pilot-version of a web-based intervention to increase physical activity and to improve diet among young adults and, in addition, to identify reasons for non-usage.

Methods

146 vocational school students (71.9 % female, mean-age: 22.7±6.0 years, mean BMI: 24.6±5.4 kg/m2) were invited via emails with individual logins to use the pilot-version of a web-based intervention (including regularly updated physical activity and healthy eating modules, social components, reminder mails). After 8 weeks, platform usage was analysed through log data. Reasons for non-usage were collected via questionnaires.

Results

47 students logged in at least once (32.2 %). There were no differences between users and non-users regarding sex (66.0 % female vs. 72.7 % female, p=0.44), age (24.0±7.8 vs. 22.1±4.8, p=0.24) or BMI (25.2±5.6 vs. 24.3±5.2, p=0.32). In total, 99 logins were tracked. Mean login frequency/user was 2.11±1.58. On overage, 12.38±20.56 logins/week were tracked (week 1: 62 logins, week 2-3: 10.00±1.41, week 4-8: 3.40±4.51). 72 of the 99 non-users listed the following reasons for non-usage: no time (54.2 % mentioned inter alia this reason), no interest/no need (50.0 %), login difficulties (5.6 %), no internet connection/no PC (4.2 %), other reasons (5.6 %).

Discussion

The platform was not used regularly and consistently and the log data show a typical high attrition rate. However, one should consider that heterogeneous target groups may cause in general smaller user rates, especially in primary care (Kelders et al., 2010). The main reasons for non-usage underline current research directions: there is a need for interactive, time-saving, low-threshold, well-designed and app-based interventions (Lewis et al., 2017). Analysing log data and determining reasons for non-usage during pilot-phases can aid to (re)adjust web-based interventions and to improve target-group specificity.

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'AESTHETIC DOPING": USE OF OIL INJECTIONS FOR BODY CONSTRUCTION AMONG BRAZILIAN BODYBUILDERS

SANTOS, A., BAHRKE, M.

UNIVERSIDADE FEDERAL DO MARANHÃO

Introduction
Anabolic-androgenic steroids (AAS) are often used to improve athletic performance and appearance (Bahrke & Yesalis, 2004). The use of appearance and performance-enhancing drugs (APEDs), including AAS, is not the only threat to the health of users. Use of oil injections to increase muscle size has recently become popular among bodybuilders. The aims of this study were to investigate use of oil injections by Brazilian bodybuilders and to document the harmful and sometimes lethal effects of using oil injections to "build" muscles, also described as 'aesthetic doping".
Methods
We combined previously published data, obtained from bodybuilders in a large northeastern Brazilian city, with new cases of oil injection documented by Brazilian national media, to highlight the number of cases of amputations and permanent damage resulting from injection of "oil" into muscles to increase size (Santos, da Rocha & da Silva, 2011). We describe how this practice has become popular among users and the increasing number of victims.
Results
We found the practice of injecting oil into muscles to be widespread, particularly in rural regions of Brazil. We found the motivation for using oil injections to be primarily to enhance appearance and "look big". Also contributing to the popularity of oil injections is ease of purchase in veterinary stores and, in comparison to the cost of AAS, oil injections are less expensive. Further, it is not unusual to find ADE (emulsifiable injection containing vitamins A, D, and E used in animals) counterfeits, where cooking oil is substituted. Injecting oil directly can cause local tissue inflammation and necrosis in extremities leading to permanent limb damage and paralysis, sometimes necessitating ablation and amputation of injured parts, or even death.
Discussion
ADE is a non-hormonal substance used in animal husbandry. Unfortunately, the current Brazilian anti-doping system is ineffective in reaching the most susceptible users - beginning recreational bodybuilders (Santos, 2015). The black market for aesthetic doping drugs thrives in Brazil, especially in rural areas, far from the eyes of the Autoridade Brasileira de Controle de Dopagem (ABCD). It's here where bodybuilding gyms are often the 'open door' for athletes and non-athletes to use illicit drugs to enhance performance and appearance (Bahrke & Santos, 2014). In Brazil, especially rural areas, anti-doping control has much work to do in implementing effective anti-doping policies.
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USING A SOCIAL MEDIA PLATFORM TO PROMOTE PHYSICAL ACITIVTY OF ADULTS: A RANDOMIZED CONTROLLED TRIAL

GRIEBEN, C., STASSEN, G., FÜLLGRAEBE, F., FROBÖSE, I.

GERMAN SPORT UNIVERSITY COLOGNE

Introduction
A lack of physical activity (PA) has been named the fourth highest mortality risk factor in humans and is thus one of the most significant health issues in today's society. It is unquestionable that physical activity strongly contributes to the prevention of abovementioned civilization diseases (Warburton, Nicol & Bredin, 2006). However, most adults worldwide do not reach current PA guidelines (World Health Organization, 2016). Internet-based interventions to promote physical activity – especially with support of social media elements – are a promising approach aimed at improving healthy behaviours (Cavallo et al., 2012). The aim of this study was to examine the effectiveness of a social media platform in regard to PA of healthy adults.
Methods
A randomized controlled trial (RCT) was conducted with 47 participants (aged 49.7±13.9 years) in Cologne, Germany 2015. Participants were randomized into two groups, an interactive vs. non-interactive group: The interactive intervention group (n= 22) received access to a PA focused social media platform with information how to adopt a healthy lifestyle. Additionally, they had the opportunity to consult health professionals and to meet each other to do sports. The non-interactive control group (n= 25) obtained only regular e-mails with the same content. PA was measured before and after the intervention period of eight weeks with the Global Physical Activity Questionnaire (GPAQ).
Results
While the Met-Score in the control group do not increase significantly between T0 and T1 (p=0.185), a significant increase in the corresponding median score can be demonstrated in the intervention group (p =0.006). The values of the intervention group differ significantly from those of the control group at the end of the intervention period (p=0.037). Total physical activity levels increased in the intervention vs. control arm (+150 MET/min/week).
Discussion
Based on the findings of this study, social media platforms to promote physical activity are shown to be a suitable measure to these health issues. To further solidify these results, a study with a larger amount of study participants is recommended, as well as studies with a longer duration and follow-up studies. This study makes an important contribution for further internet-based interventions.
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CP-PM07 Ageing

THE EFFECTS OF URSOLIC ACID AS AN EXERCISE PILL FOR ANTI-AGING

KIM, S.
CHONBUK NATIONAL UNIVERSITY

Introduction
Endurance and strength are reduced in elderly people. There are many difficulties in performing the exercise more than moderate-intensity for improving the health effectively. Ursolic acid (UA) intake can achieve the effects of endurance (Chu et al., 2015; Kunkel et al., 2012) and strength (Kunkel et al., 2011; Jeong et al., 2015) training. We would like to confirm the possibility of UA as a supplement or exercise pill for health promotion of elderly people.
Methods
Approximately 250 g of Sprague-Dawley (SD) male rats were divided into Sed (sedentary), Ex (treadmill exercise), UA (ursolic acid supplementation) and UEx (UA+Ex) groups. The left hindlimb was immobilized to induce muscle atrophy and the contralateral, non-immobilized right leg being used as an internal control. UA (5mg / kg body weight) or placebo alone (corn oil) was administrated once a day for 8 weeks. The exercise group performed running on a treadmill for 60 minutes once a day and 3 times a week for 8 weeks.
Results
The skeletal muscle weights were reduced by immobilized for 10 days in tibialis anterior (29.2%), soleus (40.0%) and gastrocnemius muscles (39.2%). The effects of UA and exercise training on skeletal muscle weight were not significant during the 8-week treatment. However, there was a positive effect in UEx group. UA treatment and exercise training were effective in metabolic parameters and to reducing the increased fat mass. However, there was no additive effect according to the concurrent treatment of UA and exercise.
Discussion
UA improves the insulin/IGF-1 signaling pathway to increase muscle mass and reduces the expression of Muscle RING-finger protein-1 (MuRF1) and Muscle atrophy F-box (MAFbx) to prevent muscle atrophy (Kunkel et al., 2011). UA also increases energy expenditure by enhancing beta oxidation through mechnisms dependent on UCP3 and AMPK (Chu et al., 2015). Therefore, additional analysis of the relevant signaling pathway is required to verify the effects of the UA alone or the concurrent treatment of UA and exercise training.
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EFFECTS OF A 12-WEEK MULTICOMPONENT EXERCISE INTERVENTION ON EXECUTIVE FUNCTIONS AND EPISODIC MEMORY IN HEALTHY ELDERLY: A PILOT STUDY

STROEHLEIN, J.K., VAN DEN BONGARD, F., BARTHEL, T., REINSBERGER, C.
INSTITUTE OF SPORTS MEDICINE, PADERBORN UNIVERSITY

Introduction
There is increasing evidence for primary and secondary preventive effects of aerobic exercise on dementia. However, different types of physical activity, such as coordination and resistance training, were also found to improve cognitive functions. It remains unclear, if and how the combination of different types of physical activity (multicomponent training, MT) might improve cognitive functions. Therefore, we conducted a pilot study to elucidate the preventive effects of 12-weeks MT on executive functions and episodic memory in healthy elderly.
Methods
20 healthy elderly subjects between 60-80 years were age- and gender-matched assigned to an MT (n= 12) or a passive control group (n= 8) (CG). The MT group exercised twice-weekly for a period of 12 weeks. Each session consisted of moderate Nordic walking, coordination and strength exercises. Assessments were made at baseline and trial completion. Primary cognitive outcomes were the Stroop Color-and-Word Test (executive function) and the German version of the Auditory Verbal Learning Test (AVLT) (episodic memory). Secondary motor outcomes were the motor basic diagnostic as well as the 6-Minute-Walk-Test (6MWT), which measured endurance performance. Standardized Mean Differences (ES) with a pre-test correction were calculated and assessed by Cohen's d.
Results
No significant changes were found at follow-up between both groups for any cognitive or motor outcome ($p > 0.05$). However, small and high ES in favor of the CG indicated a better performance than the MT group for variables of the Stroop Color-and-Word Test. Small and high ES for variables of the AVLT (short-term memory and recognition) were found in favor of the MT group. Small, moderate and high ES for motor basic diagnostic and 6MWT were in favor of the MT group. Post-hoc analysis indicated that the achieved test power was < 0.2 for both cognitive outcomes.
Discussion
12-weeks of MT did not significantly improve executive function, episodic memory or motor performance in the MT group. The intensity of the intervention might have been too low and the duration of the intervention might have been too short to induce significant behavioral improvements, especially considering the small sample size. The low statistical test power supports the need for a larger sample size to examine the effectiveness of MT interventions. The study design also had a high risk for selection, performance and detection bias due to the lack of randomization and double blinding. Future investigations may include larger sample sizes and less risk of bias.

PHENOTYPE PROFILE OF FUNCTIONAL CAPACITY AMONG COMMUNITY-DWELLING ELDERLY WOMEN AGED 60 YEARS AND OLDER FROM THREE DIFFERENT COUNTRIES

BUI, H.T., KALINOVA, E., ALLISSE, M., LÉVESQUE, P., HUOT-LAVOIE, M., ALLARD-CHAMARD, X., LAVALLIÈRE, M., LEONE, M.
UNIVERSITÉ DU QUÉBEC À CHICOUTIMI, UNIVERSITÉ DU QUÉBEC À MONTRÉAL

Introduction

In most industrialised countries, the number of individuals over 60 years of age is in constant progression. During the process of aging, it has often been observed that the functional capacity is diminished, even in people having no pathologies or handicaps. This phenomenon may have major impacts on the level of functional capacity on these populations. It is very difficult to assess and compare regional differences because of the lack of common and standardised test protocol to evaluate functional capacity. Thus, based on the UQAM-YMCA test battery (UY) the purpose of this study was to compare the functional capacity of older women from three different countries.
Methods
A total of 17 functional tests from the UY test battery were administered to 247 women aged 70.6 ± 8.4 years (mean ± SD). This test battery allowed us to assess six principal factors: 1) Static balance; 2) Speed of lower and upper limbs; 3) Muscular strength; 4) Flexibility; 5) Walking capacity; 6) Simple reaction time. The participants were evaluated in their own country (Canada, n=170; Brazil, n=35; Bulgaria, n=42) by an international team of researchers using the same test protocol and materials.
Results
The ANOVA revealed that all anthropometric variables (e.g. body mass, height and BMI) were significantly different between the three countries (Tukey, p≤0.05). Among the functional variables, 12 of the 17 variables were significantly different (Tukey, p≤0.05) despite a non-significant age difference. Most of the differences among the 12 variables are caused primarily by the Brazilian cohort (9 of 12 significant differences). Based on a discriminant analysis, 82.6% of the women were classified in the correct group (e.g. Canada, Brazil or Bulgaria). However, when anthropometric measures were taken alone, only 35.2% of the participants were classified correctly while this percentage rose to 71.4% with functional variables alone. On the 17 functional tests, the most discriminant variables were: 1. One hand plate tapping; 2. Trunk rotation; 3.Sit-and-stand; 4. Hand grip; 5. Elbow flexion; 5. Balance eyes closed; 6. Simple reaction time.
Discussion
Even when the same test protocol, tester and materials were used, many functional performance differences are still present. This study stresses the need to build regional normative data for each specific population.

RUNNING AT 'PACE WITH A SMILE' AND AT LACTATE THRESHOLD IN ELDERLY PEOPLE

SAKAMOTO, M.
FUKUOKA UNIVERSITY

Introduction
Moderate exercise intensity at the lactate threshold (LT) is considered to be the minimal intensity required to increase aerobic capacity. The purpose of this study was 1) to examine the benefit of running at a pace at which the runner can run with a smile ('pace with smile' / RPS) to compare LT in running and 2) to examine how much the LT speed in running differed from preferred transition speed (PTS) in 17 elderly people (Age: 71.0±5.2 yr, Height: 154.4±7.6 cm, Weight: 56.7±8.0 kg, BMI: 23.8±2.7 kg/m2).
Methods
An outdoor test of 1 min RPS was carried out based on 10-12 of Borg's RPE scale (around 'fairly light') or at perceived smiling and talking level, and distance was measured in order to calculate running speed. LT in running was determined by incremental exercise test. PTS was determined as a natural walk-run transition speed by increasing treadmill speed from low to high, and reducing it from high to low for run-walk transition. These tests were randomized.
Results
Even if prescribing running at smiling and talking level, the speed of RPS exceeded the LT speed in running (7.1±1.0 vs. 4.8±0.8 km/h, P<0.001). LT speed in running was significantly lower than PTS (4.8±0.8 vs. 5.9±0.7 km/h, P<0.001).
Discussion
These data indicated that 1) Running at smiling pace easily exceeds the aerobic training threshold and 2) LT speed in running is slower than PTS, indicating that slow-jogging at walking speed is optimal in elderly people.

IMPROVEMENT OF PHYSICAL FITNESS LEVELS IN HEALTHY ELDERLY PEOPLE LIVING IN RURAL JAPANESE AREAS

UEKI, S., YOSHIDA, H., SATOH, T., INUZUKA, G., TAKATO, J., KATAKURA, S., HAGA, H.
OSAKA UNIVERSITY OF HEALTH AND SPORT SCICENCES

Introduction
In recent years, it has been reported that Japanese elderly are showing improved psychological and physical functions. The purpose of this study was to clarify whether the physical fitness needed for daily living in community-dwelling elderly people in a rural area of Japan has improved over the last five years.
Methods
A total of 7,001 (males, 47.3%; females, 52.7%, in 2010) and 6,224 (males, 50.7%; females, 49.3%, in 2015) elderly residents (excluding those receiving some type of support or care) aged 65-84 years underwent measurement of their grip strength and SULF (the timed test 'Standing Up from a Long sitting position on the Floor') during a health check in Tome City, Miyagi Prefecture. The data were calculated as the mean and SD by sex and age. Significant differences in the mean were tested using a non-paired t-test in 2010 vs. 2015. The interaction by two-way ANOVA analysis of the age and measurement year (2010 and 2015) was analyzed. The significance level was less than 5%.
Results
In both the grip strength and SULF, the value for each age was significantly improved compared to five years ago. The results were analyzed for each sex, and the grip strength of 65-69-y and 70-74-y males did not show a significant difference between 2010 and 2015, but that in 2015 was significantly higher than that in 2010 among 75-84-y males. On the other hand, the grip strength of females in 2010 was significantly higher than that in 2015 for all ages. SULF of males and females in 2010 was significantly faster than that in 2015 for all ages. The interaction of the age and measurement year showed significant differences in SULF of males, and the grip strength and SULF of females. However, no significant difference in the grip strength of females was observed.
Discussion
The results suggest that the physical fitness level needed for daily living, based on the grip strength and speed of rising from the floor, has been rejuvenated by five to seven years.

HEALTH CONDITION, LIFESTYLE AND COGNITIVE FUNCTION CLASSIFIED BY EXERCISE BEHAVIOR AMONG COMMUNITY-DWELLING OLDER PEOPLE IN NORTHERN JAPAN

SASAKI, H., KOZAKAI, R., UEDA, T., IDE, K., HANAI, A., ODA, S., HOMMA, M., KURODA, Y., HONDA, R., OGAWA, H., ODAJIMA, M., AIUCHI, T., OKITA, K.

HOKUSHO UNIVERSITY

Introduction

It is well known that physical activity is one of the most important behaviors for health. Despite the important behavior, people can't change their exercise behavior. Recently, the Transthoretical Model (TTM) is used in change of exercise behavior. However, there have been few reports on the relationship between physical activities of community-dwelling older people with their health conditions and lifestyle. The purpose of the present study was to examine differences in health, diseases, sleep, food intake and cognitive function among community-dwelling older people in northern Japan based on their exercise behavior.

Methods

The subjects were 96 people aged 60 years and over, who participated in the comprehensive study for healthy longevity and completed measurements in 2015. The mean age of these subjects was 70.8±5.33 (SD) years. The questionnaire included questions about individual characteristics, health conditions, lifestyle, and exercise behavior. The questions about health conditions included subjective health level, disease history, drug use, sleeplessness, foods intake. Fitness test including grip strength, 10m maximum walking time and flexibility and cognitive function also were measured. Cognitive function was assessed by Mini-Mental State Examination (MMSE). Regarding exercise behavior, the subjects were asked whether they exercised for 30 minutes or longer twice or more each week. Their answers were classified into 5 levels by TTM stage.

Results

The number of participants of 5 exercise behavior level was as follows; 1) "did some exercise for 6 months or longer" was 38 (39.6%), 2) "started exercise within 6 months" was 1 (1.0%), 3) "did sometimes some exercise" was 21 (21.9%), 4) "must do some exercise" was 33 (34.4%), 5) "had no intention to exercise" was 3 (3.1%). The group of 2 was excluded from data analysis because of 1. The ratio of older people doing exercise sometimes was higher among those with no history of high cholesterol disease. In the people who considered continuous exercise was necessary, there was a higher ratio of pain history of hip joint. Subjects who had no intention to exercise were lower grip strength. Sleeplessness and cognitive function were not related to exercise behavior.

Discussion

Differences in health conditions and activities of daily living were identified between older people with different stage of exercise behavior. Compared to those without a disease history, older people with this history showed stronger awareness of exercise behavior. In the people who had no intention to exercise, a decline of the physical strength that is necessary for activities of daily living was supposed. A further study is needed to determine the factors that prevent exercise in older people who do not have an exercise habit, despite their intention to exercise, or in those with no such intention.

EFFECTS OF WHOLE BODY VIBRATION ON COGNITION AND MOTOR FUNCTION IN AGED RATS

TÓTH, K., OROSZI, T., SCHOEMAKER, R.G., VAN DER ZEE, E.A., NYAKAS, C.

UNIVERSITY OF PHYSICAL EDUCATION, BUDAPEST, HUNGARY

Introduction

The preventive and rehabilitative potentials of physical activity have already been proven in case of many modern diseases. However, certain special populations, like elderly and physically disabled, who would also profit from these benefitial effects, are often not able to perform exercise. Whole body vibration (WBV), meaning the sensory stimulation of the whole body via mechanical waves, can serve as an alternative to training. Previous studies, performed on both animals and humans, have shown that WBV has numerous positive physiological effects, among others on active and passive movement systems, hormonal and circulatory system. Other aspect of WBV is its impact on the brain, about which little is known yet.

Methods

18 month old, both male (n=7) and female (n=9) rats were subjected to a WBV protocol consisting of 10 minutes of vibration 5 times a week for 5 weeks. A control group for both gender was also recruited (male: n=7; female: n=8), that remained naive. After completion of the 5 weeks vibration prtocol, effects of WBV on motor system, cognition and behaviour were investigated. Regarding motor skills balancing ability was measured by balance beam test, while grip strength was assessed by grip hanging test. Concerning cognition spatial memory was evaluated by novel location recognition test, whilst declarative memory by novel object recognition test. Psychomotoric aspect of behavior was studied with open field exploration test. For statistical analysis factorial analysis of variance was used, with presence or absence of vibration and gender as the two factors.

Results

In the balance beam test vibrated rats compared to control, and female in comparison with male animals had shorter completion time. Animals of the vibrated group were able to hang for a significantly longer time in the grip hanging test. A tendency of better recognition of the object at a novel location in spatial memory test was seen in case of animals that underwent vibration treatment, disregarding gender. No difference was found in the behaviour test.

Conclusion

In accordance with previous studies, benefitial effects of WBV on motor performance was shown in balance and grip strength in both gender of an aged rat population. Better performance of female rats in the balance test could possibly be attributed to their smaller body size.

Neurogenesis and consequently cognition enhancing effects of physical activity are already known. Therefore, the better spatial memory, that was observed for vibrated rats could be due to the neurogenesis stimulating effect of WBV, similar to regular exercise. To support this notion our future plans involve biochemical and immunohistochemistry analysis of neurogenetic markers. Furthermore, we aim to establish the optimal treatment time with a dose response curve in our next investigation.

EFFECT OF CHRONIC ACTIVE AND PASSIVE EXERCISE FOR PSYCHOMOTOR AND COGNITIVE FUNCTIONS IN SENESCENT RATS

TÍMEA, T., KÁROLY, B., CSABA, N.
UNIVERSITY OF PHYSICAL EDUCATION

Introduction
During the advance aging both active and passive exercises are useful therapeutic interventions to improve physical and mental performances. In the present study both chronic moderate active (on treadmill) or passive (electromagnetic field - EMF - stimulation) exercises were introduced to rats reaching the age of 32 months in order to develop translational model for supporting healthy aging.
Methods
Male Wistar rats were treated with EMF stimulation for six weeks, 3 times per week, 24 min per sessions prior to the age of 32 months. The doses of stimulation were: 45, 92 and 1250μT (Pulse EMF stimulator: Santerra MCR System (Pinding, Germany). In case of active treadmill exercise it was applied for 6 months, 60 min for daily sessions and 3 times per week. Psychomotility was estimated in open field (OF), attention ability in novel object recognition (NOR), and spatial learning and memory in Morris water maze (MWM) tests.
Results
OF test: passive exercise enhanced novelty-induced motility after both the middle and high doses, while active exercise enhanced mainly horizontal ambulation (locomotion) in this age. NOR: passive exercise increased attention in all treated groups reflecting an enhanced attentional capability. Active exercise also enhanced NOR performance. MWM: passive exercise facilitated spatial learning in this test but only the highest dose was effective. In case of active exercise learning ability was significantly improved in the advanced phase of test.
Discussion
Results showed that both active and passive exercise is effective in senescent age to improve cognitive and psychomotor function in rats. In the age of 32 months in this rodent both of these functions are deteriorated and it is notable that with chronic exercise either with active and passive type, they can be remarkably improved. These animal studies can provide options to study the cellular and molecular mechanisms behind these treatments helping human interventions.
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CP-BN06 Balance and proprioception

EVALUATION OF BIOFEEDBACK BALANCE PLATFORM TRAINING OVER 6 MONTHS

SCHIFF, M., SCHIFF, C., LAUTENSCHLAEGER, J., GASS, A.
UNIVERSITY MEDICINE MANNHEIM, EPL EPL MEDIZINTECHNISCHE PRODUKTIONS-GMBH

Introduction
In order to maintain a stable position on a balance platform (BP) a complex interplay of sensory and motor function is required. Adaptable stability however is a prerequisite for any purposeful dynamic movement (tennis stroke, a throw, a sprint after a directional change). We report the results of a systematic intervention in subjects of different physical expertise levels who served as their own controls in a 6 month trial of a biofeedback BP exercise training.
Methods
The neurotrim BP uses 2 displacement sensors (accuracy 0.1 kohm, sampling rate 100 Hz) - one for the anterior–posterior motion, the other for the medio–lateral tilting and rotation motion—to record the movements of the platform. It is connected with a computer and a monitor. Standard signal output acquired via the displacement sensors generates digital numerical values (digits) in a measuring range of 0-1000 digits for each motion axis. This means that the movement excursion of the BP is measured in digits/ms, and based on that sway path and sway area are determined as quantitative parameters. Movement excursion of the BP (digits/ms) is also presented as visual feedback to the subjects to solve training tasks. Twelve subjects age 12-55 years (3/12 professional athletes age 20-33), followed a once weekly 90 minute training routine under guided supervision. The exercises included in each session single and bilateral leg stance challenges of individually adjusted levels of difficulty. Typically each run lasts about 60 seconds followed by rest of similar duration. Standardised assessments of single leg stance in the frontal and sagittal plane were performed at entry and after 6 months of practise and the % change of the total sway area was analysed. Subjective changes were recorded in a structured questionaire.
Results
The 12 subjects started at different levels of expertise. There was an average sway area reduction by 59 % (15%-74%) for the left leg and 58% (19%-72%) for the right leg indicating increased stability. These objective improvements were accompanied by subjective sport/activity specific improvements (tennis, football, basketball, golf) such self reported changes included 'physical activity less tiring', 'faster regeneration after activity', 'more explosive movement initiation', 'faster directional changes', 'more control of tennis or golf strokes', 'more precision when passing the ball').
Discussion
Biofeedback BP training offers stimuli, that challenge distal (foot, ankle) and proximal stabilisation (hip, torso). These functions can be objectively remarkably improved across a range of athletic levels at 6 months, which also appears to translate to subjective performance improvements.

THE EFFECT OF STATIC AND DYNAMIC STRETCHING ON KNEE JOINT PROPRIOCEPTION AND STRENGTH

WALSH, G.
OXFORD BROOKES UNIVERSITY

Introduction

The importance of warm up procedures prior to athletic performance is well established (Daneshjoo et al., 2012). Muscle stretching is a common warm up component. There is conflicting evidence regarding the effect of static stretching (SS) on knee joint position sense (KJPS) and the effect of dynamic stretching (DS) on KJPS is currently unknown (Larsen et al., 2005; Ghaffarinejad et al., 2007). However, SS has been shown to decrease physical performance, whilst the opposite has been found for DS (Haddad et al., 2014). Developing an understanding of how stretching methods during warm up procedures effects muscle strength and proprioception will have important implications for sporting performance and injury risk. The aim of this study was to determine the effect of dynamic and static stretching as part warm up procedures on KJPS and knee extension and flexion strength.
Methods
Ten healthy adults (20±1 years) attended 3 visits during which baseline KJPS, at target angles of 20° and 45°, and concentric knee extension and flexion strength tests were followed by 15 minutes of cycling and either a rest period (CON), SS, or DS of the knee extensors and flexors. KJPS and strength tests were repeated immediately following warm up and stretch conditions. All proprioception and strength tests were performed on an isokinetic dynamometer. Data were analysed using a two-way MANOVA.
Results
There were warm up x stretching type interactions for KJPS at 20° ($p=0.024$) and 45° ($p=0.018$), and knee flexion ($p=0.002$) and extension ($p<0.001$) strength. The SS and DS improved KJPS but CON condition did not and SS decreased strength with no change present for DS or CON.
Discussion
Both SS and DS improve KJPS as part of pre-exercise warm up procedures, supporting previous findings for SS (Ghaffarinejad et al., 2007). Greater KJPS has been related to reduced knee injury risk (Ogard, 2001). However, the negative impact of SS on muscle strength limits the utility of SS before athletic performance. This study is the first to examine the effect of DS on KJPS and the results suggest that 3 sets of DS for 2 muscle groups about the knee (quadriceps and hamstrings) was sufficient to improve KJPS but did not alter muscle strength. Therefore, DS offers a viable alternative to SS for exercise preparation due to its ability to improve KJPS without detriment to muscle strength.
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Contact
gwalsh@brookes.ac.uk

ANKLE INVERSION DISCRIMINATION WHEN WEARING DANCING OR EVERYDAY SHOES IN PRE-SCHOOL RECREATIONAL DANCERS

LU, L., HAN, J., WADDINGTON, G., ADAMS, R., ANSON, J.
SHANGHAI UNIVERSITY OF SPORT ;UNIVERSITY OF CANBERRA

Introduction
Evidence has shown that wearing dancing shoes has an effect on ankle inversion discrimination accuracy in professional dancers. It is undetermined if this finding also holds for pre-school recreational dancers. To investigate the effect of wearing dancing or everyday shoes on ankle inversion discrimination ability in pre-school recreational dancers.
Methods
Twenty right-footed pre-school recreational dancers (10 M and 10 F; mean 6.9 years, range 6-8; mean 126.0 cm tall, range 119-141.5 cm; mean 26.2 kg, range 20.3-40.4 kg; mean 31.9 foot size, range 30-36) participated in this study. Ankle proprioception was measured by using the active movement extent discrimination apparatus (AMEDA). During the tests, participants were asked to discriminate 4 ankle inversion depths (10, 12, 14, and 16 degrees) in standing position, with barefoot or wearing dancing or everyday shoes. Pearson's correlations were calculated between anthropometry measures and ankle proprioceptive discrimination AUC scores. A 3X3 repeated measures ANOVA was conducted to examine shoe condition (barefoot, dancing shoes and everyday shoes) and inversion depth (10 vs 12, 12 vs 14, 14 vs 16 degrees) on ankle proprioceptive performance.
Results
Ankle proprioceptive discrimination AUC scores were significantly correlated with age, height and shoe size ($r=0.47$, $p=0.04$; $r=0.51$, $p=0.02$; $r=0.62$, $p<0.01$). Participants performed equally well when barefoot, or wearing dancing or everyday shoes ($F=0.82$, $p=0.38$). However, there was a significant linear effect across the 3 pairs of inversion depths ($F=4.84$, $p=0.04$), and the deeper inversion, the worse discrimination accuracy.
Discussion
The significant correlations between ankle proprioception and anthropometry measures suggest that proprioceptive system is still developing in 6-8 year-old children. Although these pre-school recreational dancers were able to adapt to different foot wares and performed equally well in the ankle AMEDA tests, the finding that worse inversion discrimination ability associated with larger inversion depths supports the use-dependent theory, suggesting that specific training targeting on deeper inversion, with or without shoes, may be effective for potential ankle injury prevention.

THE INFLUENCE OF HEARING LOSS ON POSTURAL, CERVICAL ROM AND NECK EMG PARAMETERS

THOMAS, E., MESSINA, G., BIANCO, A., MARTINES, F., PALMA, A.
UNIVERITY OF PALERMO

Introduction
Balance is a complex process that involves multiple sensory integrations. Hearing, visual and vestibular systems are the main contributors. Hearing loss may induce inappropriate postural strategies that could affect the cervical spine. The aim of the study was to understand if hearing loss influences postural parameters, cervical ROM and sternocleidomastoid EMG amplitude.
Methods
13 patients (61±13 year; 161.8±11.0 cm; 70.5±15.9 Kg) with moderate hearing loss (Right ear -60±21 dB; Left ear -61±24 db) underwent: 1)postural examination (CoP, ellipse, X and Y deviations with open and closed eyes) through a stabilometric platform, 2)cervical ROM examination through a head accelerometer and 3) sternocleidomastoid EMG examination.

Results
No differences were found between right and left hemibody between the audiometric, posturographic and cervical ROM parameters and in EMG amplitude. ROM and EMG parameters are not associated to hearing loss, for both right or left head rotation. Multiple regression analysis has shown a negative regression coefficient (R2 -0.69) between hearing loss and the posturographic parameters associated to postural control and balance(CoP, ellipse Xmed and Ymed).
Conclusion
Posture and balance are affected by moderate hearing loss. Head rotation and muscle activation of the sternocleidomastoid are not affected by hearing impairments.
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EFFECTS OF THERAPEUTIC EXERCISE ON PAIN, RANGE OF MOTION, STRENGTH AND BALANCE IN A PATIENT WITH ANTERIOR ANKLE IMPINGEMENT: A CASE STUDY

LEE, S.A.1, KIM, A.R.1,2, LEE, S.Y.1, LEE, H.S.1
1: DANKOOK UNIVERSITY (KOREA, SOUTH) 2: NAMSEOUL UNIVERSITY (KOREA, SOUTH)

Introduction
Anterior ankle impingement (AAI) is a common clinical condition characterized by chronic anterior ankle pain that is exacerbated on dorsiflexion. Additional symptoms include instability; limited ankle motion and pain (Talusan et al., 2014). Treatment of AAI with surgery has provided good results historically, but at the price of significant complications (Ross et al., 2016). In this respect, it is necessary to consider the application of nonsurgical methods such as therapeutic exercise including improve joint stability, muscle strength and balance training in the patients with AAI. The purpose of this study was to determine the effect of therapeutic exercise on ankle pain, ankle joint range of motion and strength, and balance in a patient with AAI.
Methods
A-32-year-old male presented limited ankle motion and pain with forced dorsiflexion at both ankle joints. The therapeutic exercise program consisted of ankle joint mobilization, strength and proprioceptive exercises. The program was performed for 40 min/day, twice per week, for 8 weeks. Pain (visual analogue scale; VAS), range of motion (ROM), and muscle strength (ankle dorsiflexion, plantarflexion, inversion, and eversion) and one-legged standing test of both ankles were measured before, after 4 and 8 weeks of therapeutic exercise.
Results
VAS decreased in both ankles after 8 weeks of exercise, respectively, compared to baseline levels. Range of motion and strength increased in both ankles for dorsiflexion, plantarflexion, inversion, and eversion after 8 weeks of exercise compared to baseline levels. In addition, the ability to perform a one-legged standing test with eyes opened and closed improved in both legs after 8 week of exercise compared to baseline levels
Discussion
Generally, AAI have been described as an either mechanical and functional instability of ankle joint (Powers et el., 2004). Ankle instability relates to posture, muscle, and proprioceptive deficits. (Patrick and Battaglia, 2015). It has also been reported that proprioceptive and muscle strengthening exercises are important for the rehabilitation of AAI (Kim et al., 2016). Therefore, therapeutic exercise for relieving ankle pain and improving functional ability in a AAI patient is probably associated with improved range of motion of the Ankle and balance, muscle strength. These results suggest that therapeutic exercise improves pain, ROM, muscle strength, and balance in patients with AAI.
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Contact
hoseh28@dankook.ac.kr

EVALUATION OF BALANCE BY THE STABILOMETRY OF BRAZILIAN JIU JIUTSU ATHLETES BEFORE AND AFTER FIGHTS

EDUARDO, A., BARBIERI, S., OLIVEIRA, P., VIANNA, L.S., DUTRA, M., MORAES, F.S., BULGARELLI, P.
FACULDADE MAX PLANCK

Introduction
The aim of this paper was to evaluate the balance through the plantar distribution of Brazilian Jiu Jitsu athletes (BJJ). The BJJ is a fight that aims at the submission of the adversary, especially from solo techniques. Thus, the athlete seeks the projection of the opponent to the ground to then try to master it through specific techniques such as immobilization, arm lock and strangulation. The dominance of the center of gravity of the human body and the distribution of body weight in dynamic actions can provide better performance in activities that need good balance, as in fights. Balance is a complex system, which involves capturing external information and internal feedbacks from the central, peripheral nervous system of the osteomuscular system in constant adaptation to keep the movements coordinated and synchronized. As the fatigue in a fight, physical abilities suffer a brief decline, which decreases sportsmanship, speed of reaction and balance. The postural balance of the human body is related to the afferent vestibular and auditory pathways, there is a close relationship between balance and auditory changes. The orthostatic posture of the human being is influenced by different factors, such as breathing, heartbeat, venous return, which generate constant oscillations in the body balance, which can be ascertained through the displacement of the pressure center. The reflex sensory relationships, velicodade of the eye during the movement movements of the strides in the locomotion are directly linked to the maintenance of the body posture.
Methods
Fifteen practicing subjects of BJJ were evaluated more than 3 years ago. A 20-second collection was performed on a FOOTWORK PRO baropodometer with open eyes and closed eyes. Three bouts were relayed, with 10 minutes of rest between the fights. The subjects

remained in parallel feet orthostatic with abduction of 30 degrees between the feet. They were directed to look at a fixed point on the wall ahead at eye level. The laboratory was noise-free so as not to interfere with the acquisition of baropometry data.
Results
The pre-fight stabilometry showed a mean posterior oscillation of 2.34, standard deviation 0.5 and a lateral oscillation of 1.9 with a standard deviation of 0.9. After the combats the anterior anterior oscillations were 8.4, standard deviation 4.3 and lateral of 5.9 and standard deviation of 3.2.
Discussion
After combating muscle fatigue, increased post-exertion heart rate, increased respiratory rate with decreased diaphragmatic incision, led to an increase in both anterior and posterior oscillation. This can lead you to suffer a fall during a fight, but also due to its greater oscillation of its center of gravity which can harm during combat. This study does not close the balance document in BJJ athletes, and further studies are needed to deepen the knowledge.

EFFECT OF CROSS-TAPING OF PLANTAR CALLUSES ON DYNAMIC AND STATIC BALANCE IN SOCCER PLAYERS

KIM, S.J., LEE, J.H.

DEPARTMENT OF PHYSICAL THERAPY, DONG-EUI UNIVERSITY, BUSAN, REPUBLIC OF KOREA

Introduction
For soccer players, balance on the supporting foot is essential for ball control. The purpose of the present study was to identify changes in dynamic and static balance in soccer players with cross-taping of plantar calluses.
Methods
The participants consisted of 19 soccer players with plantar calluses. Cross-taping was applied to plantar calluses (Danaka Novdaka, 2007) in the experimental group, and to the top of the foot in the control group. Dynamic and static balance with eyes closed was assessed with the Romberg test using BioRescue (RM INGENIERIE, Rodez, France). The data were analyzed using SPSS 18.0 for Windows, and the p value for significance was set to 0.05. A paired t-test was performed to compare the within-group changes in static and dynamic balance before and after taping, while an independent t-test was performed to compare the amount of change in static and dynamic balance between the experimental and control groups.
Results
In the experimental group, the dynamic balance Romberg test results indicated that the center of pressure showed significant changes in length and average speed after tape application ($p<0.05$). On the other hand, the static balance Romberg test results indicated no significant changes. The control group did not show any significant changes in either the static or dynamic balance Romberg test results.
Discussion
The findings in the present study showed that cross-taping of plantar calluses increased dynamic balance. There have been many recent studies on the effects of taping on balance ability. Lee BG & Lee JH (2015) reported that taping of unstable ankles resulted in increased dynamic balance, while Lee SM and Lee JH (2015) reported that ankle taping of patients with eversion sprains improved balance and range of motion. Although the number of tapes applied depended on the number of plantar calluses, the present study demonstrated that cross-taping of calluses, rather than conventional ankle taping, improved dynamic balance.
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Contact
dreampt@hanmail.net

EFFECTS OF THE USE OF SEMI-RIGID ANKLE STABILIZERS IN VERTICAL JUMP IN VOLLEYBALL ATHLETES

REYS, F., COSTA, G., RUSSOMANNO, T.

UNIVERSITY OF BRASILIA

Introduction
Usually volleyball players use a lot ankle stabilizers to prevent injury, however it is not clear whether this affects the performance of vertical jump during the game. Therefore, the aim of this study was to analyze the effect of semi-rigid ankle stabilizers in vertical jump performance of volleyball players.
Methods
An ankle stabilizer was tested in 15 university female volleyball players during a session of 2 types of jumps: one with counter movement jump and other doing the volleyball block jump in 2 different conditions (with and without the stabilizer). The session of jumps was randomized. Players performed 3 jumps in each condition and in each kind of jump, with an interval of 1 minute between jumps. The ankle stabilizer used was the same for all players (Active Ankle trademark). The test was performed using a AMTI® force plate with an acquisition frequency of 100Hz (model BP400600-HF-2000) The performance of the athletes was measured based on the flight time using a MATLAB® function. Statistical analysis was performed using two-way ANOVA for repeated measures using the SPSS software version 22.
Results
All athletes had a better performance (height achieved) doing the volleyball blocking jump against the counter movement jump regardless the condition. Vertical jump height showed no significant difference between the conditions (with or without stabilizer), however, showed a significant difference $p=0.00$ for jump types.
Discussion
The Active Ankle stabilizer did not show significant difference in volleyball athletes jumps, findings that were also mentioned in the works of Anjos (2009), Jatin (2011) e Cordova (2002). As observed in the results of this study the height of the countermovement jump were significant lower than the volleyball blocking jumps. However, considering that there are few studies evaluating the gestures' dynamics, further researches on standardizations using gestures that represent the sports movement the closest should be performed and also the estimation of the impulse should be measured.
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DIFFERENCE IN UNILATERAL POSTURAL STABILITY BETWEEN THE FUNCTIONALLY DOMINANT AND NON-DOMINANT LIMB OF MALE COLLEGE BASKETBALL PLAYERS

ONDRA, L., NATESTA, P., SVOBODA, Z.

PALACKY UNIVERSITY OLOMOUC

Introduction

The single-leg balance test, applied for comparison of stability between the dominant and non-dominant limb in various sports disciplines, is also used in rehabilitation to compare the performance of uninjured with the injured limb (Hoffman et al., 1998). During the dynamic action, the non-dominant limb is responsible for stability of the dominant limb in the course of the specific movement (Schneiders et al., 2010). The aim of the study was to verify the existence of any difference during a unilateral postural stability task between the functionally dominant and non-dominant limbs in male college basketball players.

Methods

A total of 22 male college basketball players (age 16.82 ± 1.53 years) performed six unilateral stances using a force platform (Kistler 9286AA, Kistler Group, Winterthur, Switzerland) and a balance pad (Airex balance pad, Airex AG, Sins, Switzerland) placed on the platform. Three standard tests were used to determine functional limb dominancy (step up, balance recovery and ball kick test). Each participant performed in total three consecutive unilateral stances (30 sec per trial) in eyes-open condition for each limb. Centre of pressure (COP) parameters (sway, velocity) in anterior-posterior and medial-lateral directions were computed for both the dominant and the non-dominant limbs. Paired t-test ($p < 0.05$) was used to quantify the differences between the limbs.

Results

Statistically significant difference ($p=0.043$) in velocity was found in the anterior-posterior direction - higher mean COP velocity in anterior-posterior direction for the dominant limb (non-dominant – 3.13 ± 0.62 cm/s; dominant 3.33 ± 0.64 cm/s). No significant difference was established for medial-lateral direction.

Discussion

Based on the results of the current study, we found that the non-dominant limb has better stability in the anterior-posterior direction. This supports the view that the functional role of the non-dominant limb is stabilizing, supporting, mobilizing and pivoting the body (Hatta et al., 2005). On the other hand, the dominant limb appears to be stronger during dynamic action demanding explosive power like single leg jump or running single leg jump in basketball players and other athletes (Sugiyama et al., 2014; Meylan et al., 2010).

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Contact

lukas.ondra91@gmail.com

ACCURACY OF PEDOPED INSOLE FORCE-SENSORS FOR THE QUANTIFICATION OF RUNNING-RELATED PARAMETERS

SEIBERL, W.1, JENSEN, E.2,3, MERKER, J.1, LEITEL, M.1, SCHWIRTZ, A.1

1 TECHNICAL UNIVERSITY OF MUNICH, 2 EVALU GMBH, 3 NOVEL GMBH

Introduction

Running generates high, repetitive joint loads and is associated with a high injury rate, with between 20 and 80 percent of runners affected (van Gent et al. 2007). Force plates and 3D motion analysis systems represent the "gold standard" in running biomechanics research aiming to identify the sources of these injuries. However, these measurements are generally limited to laboratory analyses, where natural running is restricted (Mann et al., 2016). Therefore, it is of interest to obtain high quality field data on running kinetics. A new device (pedoped, novel, Germany) can be used to monitor the total ground reaction force (GRF) using a single flat sensor in the form of a shoe insole. This work aims to analyze the accuracy of pedoped sensors compared to a gold standard for quantifying running-related biomechanical parameters.

Methods

Ten healthy subjects were recruited for this study. The GRF was synchronously measured with a force plate (AMTI, USA; 1kHz) and pedoped devices (100Hz) for five left- and five right-foot trials under both forefoot and heel-strike unshod running conditions. Tests were performed at four instances in time, each separated by 30min of running on a treadmill. Data of both devices were processed using custom Matlab software (MathWorks Inc.). Active peak force (APF), ground contact time (GCT), and impulse (IMP) were compared between the two systems. Parameter reliability was tested using the intraclass correlation coefficient (ICC) and repeated measures ANOVA (Friedman tests) was used to identify whether the errors changed over time (% error to force plate). The alpha level was set to 0.05.

Results

Mean differences in GCT were 1.4±0.6% and 1.7±1.2% for FF and RF running, respectively (ICCs > .99). Pedoped sensors slightly underestimated APF with mean differences to force plate measurements of 6.6±3.6% and 5.3±2.6% for FF and RF, respectively (ICCs >.92). IMP was also underestimated for both running conditions (FF: 5.2±3.0%; RF: 4.2±2.7%; ICCs >.95). There was no influence of running time on error levels.

Discussion

Based on our results, pedoped force sensors can quantify running peak force and impulse with less than ten, and ground contact time under five percent error. Furthermore, ICCs to the gold standard were always higher than 0.92 and the error level was constant over 90 minutes of running use. As all tests were performed in the unshod condition, it is unclear if and how intrinsic forces in shoes may affect the interpretability of the insole sensor data. The low error rates quantified in this study are satisfactory for applications in field measurements of GCT, APF, and IMP.

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Contact

wolfgang.seiberl@tum.de

Conventional Print Poster

CP-PM10 Strength training

ACUTE EXERCISE-ASSOCIATED SKIN SURFACE TEMPERATURE CHANGES AFTER STRENGTH TRAINING WITH DIFFERENT EXERCISE INTENSITIES

WEIGERT, M., KUNERT, F., LÖSCH, C., NITZSCHE, N., SCHULZ, H.

TECHNISCHE UNIVERSITÄT CHEMNITZ

Introduction
Resistance exercise affected blood circulation. It is supposed, that this changes are measurable thermographically by skin surface temperature (T). Several studies detected changes in T after strength training but the results are inconsistent and the studies are not comparable (load characteristics, measurement time points). Therefore, this study investigated the intensity-dependent reaction of T on strength training in a strongly standardized protocol.
Methods
Ten healthy male subjects (24.5±2.0 years; BMI 24.3±1.6 kg/m2) participated. After acclimatization (15 min), the participants completed three sets (ten repetitions, two min rest between the sets) of unilateral biceps curl with 30, 50 or 70% of one-repetition-maximum in a randomized order on three nonconsecutive days (room temperature: 22.1±0.5°C, humidity 35-40%). T of the loaded and unloaded biceps was measured at rest (Trest), immediately following set 1, 2 and 3 (TS1,TS2,TS3) and post exercise (T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T15,T20,T25,T30 min after the final set) with an infrared thermal camera (FLIR A35).
Results
Two-way ANOVA detected a significant effect of the measuring time point on the T-values (Trest to T30) of the loaded arm for 30% (Eta2=0.85), 50% (Eta2=0.88) and 70% (Eta2=0.85) ($p<0.05$). The time effect was independent of the intensity ($p>0.05$). One-way ANOVA showed a significant higher T of the biceps surface compared to Trest at TS2 to T15 (30%), TS3 to T20 (50%) and T1 to T15 (70%) ($p<0.05$). Maximum temperature difference to Trest (ΔTmax=Tmax-Trest) and time to ΔTmax (min after the final set) was 1.66°C, 4.6min; 1.86°C, 5.2min; 1.83°C, 6.4min at 30, 50 and 70% respectively. The intensity had no effect on ΔTmax or time to ΔTmax ($p>0.05$). The unloaded arm showed no significant difference of T to Trest at any time point ($p>0.05$).
Discussion
Previous investigations showed a decrease of T in the strained muscle area after squat exercise[1], no changes[2] or a rise after heel lifts[3] and biceps curls[4,5]. This study indicate a rise of T independent of the exercise intensity. The temperature-time-courses had a similar pattern in all intensities but time to ΔTmax was shorter at low intensities ($p>0.05$). The rise of T is a possible result of an increased blood circulation of the skin, rubbing heat of the myofilaments or heat development due to metabolism.
Conclusion
Strength training led to an increased T of the stressed muscle region independent of the exercise intensity.
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EFFICACY OF 12 WEEKS OF COMBINED ENDURANCE AND RESISTANCE TRAINING AMONG WOMEN WITH MULTIPLE SCLEROSIS

CORREALE, L., CODRONS, E., MALLUCCI, G., DELL'ANNA, S., JONGHI LAVARINI, G.D., LIBERALI, G., MONTOMOLI, C., BERGAMASCHI, R., VANDONI, M.

UNIVERSITY OF PAVIA

Introduction
Previous studies have described positive effects of physical activity on muscle strength, fatigue and quality of life in patients with multiple sclerosis (MS). Despite combined training is recommended to prevent secondary disease and to enhance muscular strength, literature in this field suffers from heterogeneity of protocols, populations and lack of information about psychological parameters. This study is designed to investigate the efficacy of combined training on muscle strength, functional capacity, fatigue, quality of life and psychological outcomes in women affected by mild to moderate MS.
Methods
Six women with mild to moderate MS (mean age 42.1± 8.3) performed 3 times a week for 12 weeks a protocol of supervised combined training. Each workout was structured by 3 resistance exercises for body portions (lower, high portion and torso) with 8-10 repetitions for each exercise for 3 sets and 20 minutes of endurance training. At baseline and 12 weeks after the completion of the protocol training, patients filled 3 questionnaires (MFIS-21, MSQOL-54 and BDI-2) and performed 7 physical tests: body composition, Sit and Reach (S&R), Handgrip (HG), 1 Repetition Max test (1RM) for Leg Extension, Chest Press, Rowing and Maximal Voluntary Isometric Contraction (MVIC) for Leg Extension. Paired simple t-test was used to determine statistically significant mean difference ($p<0.05$) at the end of protocol.
Results
MVIC increased for all subjects (right +69.3; p=.03; left +47.6; p=.02; both +129.5; p=.04; N•m), similarly 1RM increased significantly in Leg Extension and Chest Press (+11.2; p=.02; +7.5; p=.009; Kg) but not in Rowing (+2.1 Kg; p=ns). Neither HG and S&R test increased significantly (+1.9 Kg; p=ns; +0.2 cm; p=ns). Weight decreased from 51.4±8.7 to 50.3±9.1 Kg (p=.04). Physical and psychosocial fatigue significantly decreased (-9.2; p=.02; -2.3; p=.01). Quality of life improved significantly in "physical function" and "sexual satisfaction" (+4; p=.002; +1.1; p=.04). Finally, depression decreased from 19±10.3 to 11±6.5 (p=.006).
Discussion
Our training protocol demonstrated to be useful in persons with mild to moderate MS ameliorating not only physical performances but also psychological conditions and quality of life.
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Contact
luca.correale@unipv.it

THE EFFECT OF A THREE MONTH, LOW-WEIGHT-HIGH- REPETITIONS EXERCISE PROGRAM ON PHYSICAL FITNESS AND BODY COMPOSITION IN ADULT WOMEN

GIANNAKI, C.1, EVANGELOU, C.1, HADJICHARALAMBOUS, M.1, PETROU, P.1, APHAMIS, G.1, SAKKAS, G.2
1. DEPARTMENT OF LIFE & HEALTH SCIENCES, UNIVERSITY OF NICOSIA, CYPRUS;2.DEPARTMENT OF SPORT AND HEALTH SCIENCES, UNIVERSITY OF ST MARK & ST JOHN, PLYMOUTH, UNITED KINGDOM

Introduction
Low-weight-high-repetitions (LWHR) programs constitute a popular group-based form of exercise in the gym and sports centres, accompanied by various physical fitness and health benefits (Nicholson et al., 2015; O'Connor et al., 2003). However, the effect of such programs on cardiorespiratory fitness is still controversial. The aim of the current study was to examine the effects of a 3-month group exercise program on cardiorespiratory fitness, body composition and overall health in inactive adult women.
Methods
Thirty-nine healthy adult women agreed to take part in this 3-month intervention study. Twenty six women (39.8±9.1y), were assigned to a LWHR pre-choreographed group fitness program, and sixteen women (39.1± 12.2 y) were assigned to a Pilates group fitness program. Both programs were performed 3 times per week. Various physical fitness-related parameters such as cardiorespiratory fitness, flexibility, handgrip strength and lower extremities explosive power were assessed by a battery of field tests, before and after the 3 month intervention period. Total body fat and trunk fat levels were assessed by bioelectrical impedance analysis. Heart rate response during the two exercise programs was recorded every month using a telemetry system.
Results
Following the intervention period, cardiorespiratory fitness (p= 0.001), lower extremities explosive power (p= 0.001) and total body fat (p= 0.012) significantly improved only in the women of the LWHR group. On the other hand, flexibility appeared improved significantly only in the women of the Pilates group (p= 0.032).
Discussion
Low-weight-high-repetitions, group-based exercise programs could significantly improve various aspects of physical fitness, including cardiorespiratory fitness, in inactive adult women. This form of exercise is well tolerated by women of the general population and could be used as an alternative method to the traditional cardiorespiratory exercise training in terms of improving physical fitness and body composition.
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COMPARISON OF THE RECOVERY RESPONSE FROM HIGH INTENSITY AND HIGH VOLUME RESISTANCE EXERCISE IN TRAINED MEN.

BARTOLOMEI, S.
UNIVERSITY OF CENTRAL FLORIDA

Introduction
Resistance training can induce muscle damage and a reduction in force production (Byrne and Eston 2002). The magnitude of these deficits may be dependent upon the type of training program utilized (Aboodarda et al. 2011). The purpose of this study was to compare the physiological responses of a high-volume (HV; 8 sets of 10 repetitions) versus high-intensity (HI; 8 sets of 3 repetitions) resistance training protocol in resistance-trained men.
Methods
Twelve men (24.5±4.2 y; 82.3±8.4 kg; 175.2±5.5 cm) with 6.3±3.4 y of resistance training experience performed each protocol in a counterbalanced, randomized order. Performance [counter movement jump (CMJP), isokinetic (ISOK) and isometric leg extension (MVIC), isometric mid-thigh pull (IMTP) and isometric squat (ISQ)] and muscle morphological (cross sectional area [CSA] of vastus lateralis) assessments were performed at baseline (BL), and 30-min (P-30min), 24-hr (P-24hr), 48-hr (P-48hr) and 72-hr (P-72hr) post-exercise for each testing session. In addition, endocrine (testosterone and cortisol), inflammatory (interleukin-6 [IL-6] and C-reactive protein [CRP]), and markers of muscle damage (creatine kinase [CK], lactate dehydrogenase [LDH] and myoglobin [Mb]) were assessed at the same time points.
Results
Significantly greater reductions in CMJP ($p<0.001$), peak torque during both ISOK ($p=0.003$) and MVIC ($p=0.008$) at P-30min were detected in HV compared to the HI protocol. MVIC was still impaired at P-72hr following the HV protocol, while no differences were noted following HI. Markers of muscle damage (LDH, CK, Mb) were significantly elevated following both HV and HI ($p<0.05$), while cortisol and IL-6 concentrations were significantly elevated at P-30min following HV only ($p<0.001$ and $p=0.020$, respectively).
Discussion
Results indicate that high volume resistance exercise results in greater performance deficits, and a greater extent of muscle damage than a bout of high intensity resistance exercise.
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BIOMECHANICAL MUSCLE PHYSIOLOGY – MUSCLE QUALITY AND ITS INFLUENCE ON STRENGTH CAPACITY IN SPINE AND THIGH MUSCLES

INHUBER, S.1, KREUZPOINTNER, F.1, BAUM, T.2, SCHWIRTZ, A.1

TECHNICAL UNIVERSITY OF MUNICH

Background
Lots of body fat means a high prevalence of diseases and physical limitations. Many investigations were conducted to point out the characteristics and physical effects of different kinds of body fat on health and body function. Concerning physical limitations, studies confirm the negative influence of intramuscular fat infiltrations (IMAT) on musculoskeletal structures (Kumar et al., 2014). Some radiological investigations state a conspicuous high fatty infiltration (IMAT) in spine muscles and a relation to pain/disability and structural abnormalities in the lumbar spine (Dahlqvist et al., 2014; Teichtahl et al., 2015). There is a lack of knowledge whether this high value of IMAT in spine muscles affects the strength capacity as well as the overall muscle function.
Purpose
The particular aim of the study is to investigate, whether or not there is a significant relationship between intramuscular fat and the strength of the muscle (Maffiuletti et al., 2008). The present results of a case-by-case based pilot study (Baum et al., 2016) show remarkable tendencies and form the basis for this pending research project.
Methods
30 healthy subjects (n=15 male; n=15 female) aged from 20 to 40 with a wide range of BMI (23-30 kg/m2) and an average physical activity (<4h/week) will participate in the measurements. Muscle composition, muscle volume, anatomical cross-sectional area (ACSA) and intramuscular adipose tissue (IMAT) are determined by using quantitative MR-imaging. Muscle function, especially the actual maximum voluntary contraction (MVC), is measured with a rotational dynamometer (Isomed2000): Maximum isometric torque (Nm) of trunk extension and flexion is taken in a 90°-sitting-position. To get more specific fundamental background information, the same parameters or even more are going to be investigated by quantifying the IMAT as well as measuring the MVC (60°-knee flexion angle) and additionally by using the ultrasound to determine the physical cross-sectional area (PCSA) of the quadriceps muscle.
Outlook
A feasible correlation could be used in clinical application, e.g. as one assistant detail to improve the diagnostic imaging of patients with low back pain, as well as in applied sport science as a starting point to examine the effects of different types of training on the muscle quality, more specifically on the strength-fat-relation.
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LIVER FUNCTIONS AND HORMONES LEVEL IN KUWAIT RECREATIONAL BODYBUILDING ANABOLIC-ANDROGENIC STEROID ABUSERS

YOUSEF, H., ALKATAN, M., ALSHARJI, K., HAIAT, M.

COLLEGE OF BASIC EDUCATION- KUWAIT

Introduction
Resistance training is becoming increasing popular in the Middle East, especially in Kuwait. At the same time, the use if anabolic-androgenic steroid (AAS) has been tremendously increasingly by Kuwaiti recreational bodybuilders in quest of gaining muscle mass and body image.
Purpose
The purpose of the present study was therefore to determine the side affect of anabolic-androgenic steroid on Kuwait recreational bodybuilding who been using AAS.
Methods
Blood parameters of male bodybuilding (n=70; age=27±2 yr) who been using AAS were studied. Results: Alanine aminotransferase (ALT; 50.5±3) and aspartate aminotransferase (AST; 42.4±5) were higher comparing with normal values 0-40, 0-35 respectively. Moreover, in regard hormones both testosterone (20.4±1) and estradiol (59.8±1) were higher than normal values (86.7±4) respectively.
Conclusion
In conclusion, almost most bodybuilding abusing AAS will experience side effect, including live dysfunction. Therefore, the ministry health in Kuwait should implement tough regulation and increase the awareness among the recreational bodybuilding from potential health problems form AAS.

GREATER INCREASE IN MUSCLE MASS AND IN TYPE I-FIBRE NUMBER AFTER QUADRICEPS STRENGTH TRAINING WITH ECCENTRIC OVERLOAD DURING REHABILITATION AFTER ACL-RECONSTRUCTION

PROFIT, F., GWECHENBERGER, T., WEIBERG, N., WEBER, M.A., STREICH, N., BARIÉ, A., FRIEDMANN BETTE, B.

UNIVERSITY HOSPITAL, OLYMPIC TRAININGCENTER, CLINIC ST. ELISABETH (HEIDELBERG)

Introduction
Quadriceps muscle atrophy is regularly observed after anterior cruciate ligament reconstruction (ACL-R). The aim of the study was to find out if muscle regeneration after ACL-R can be augmented by one-legged quadriceps strength training with eccentric overload (CON/ECC+).
Methods
Biopsies from the vastus lateralis muscle were obtained from 37 recreational athletes (25±4 yrs, 181±7 cm, 83.5±15 kg) after 12 weeks (wks) of regular rehabilitation following ACL-R [quadriceps tendon autograft (Q), n=22 or semitendinosus tendon autograft (S), n=15] and again after 12 wks with 2x/wk either conventional (CON/ECC, n=16 or CON/ECC+, n=21) supervised leg press training (random assignment). Immunohistochemical analyses were used to determine muscle fibre type distribution and fibre cross sectional area (FCSA). Quad-

riceps cross sectional area (CSA) was measured with magnetic resonance imaging. Isokinetic knee extension strength tests were performed at 60°/s (ST60) and 180°/s (ST180).
Results
Two-way repeated measurement ANOVA revealed a significantly (p=0.003) greater increase in CSA after CON/ECC+ compared to CON/ECC (81.7±13.1 to 96.3±14.7 cm2, p<0.001 vs. 78.5±12.1 to 87.0±11.8 cm2, p<0,001) and a significantly (p=0.022) different change of type I-fibre number with a significant increase after CON/ECC+ only (35.7±17.1 to 41.7±15.8 %, p=0.002 vs. 36.6±13.0 to 35.1±10.4 %, n.s.). Type I/type II-hybrid fibres showed a significant decrease in both training groups (7.7±4.9 to 4.8±3.6 %, p=0.004, CON/ECC, 7.1±6.5 to 4.0±4.5 %, p=0.021, CON/ECC+), while type II-fibre number did not change significantly. A significant increase in FCSA was observed for all fibre types (p≤0.003, CON/ECC: Type I: 4087±764 to 4593±961 µm², type II: 4723±1160 to 5642±1544 µm; CON/ECC+: Type I: 3914±1041 to 4599±996 µm², type II: 4440±1119 to 5221±1359 µm²). ST60 as well as ST180 were significantly improved (p<0,001) after the 12wks training period, however, without difference between the training groups.
Discussion
The development of muscle hypertrophy was significantly greater after 12wks of CON/ECC+ compared to CON/ECC during rehabilitation after ACL-R. However, CON/ECC+ induced a slower muscle phenotype, probably an explanation for the lack of difference between the training groups in the improvement of quadriceps strength. Supported by the Dietmar Hopp Foundation (23011193)

THE EVALUATION OF BALANCE, FLEXIBILITY AND EXPLOSIVE STRENGTH IN ELITE REFEREES AND ASSISTANT REFEREES

ANGIN, E., KIRMIZIGIL, B., IYIGUN, G., KUTUKUT, E., SEZEREL, B., TECER, H., BABAYID, G., OZYAKUP, B., CHAUCHAT, C.J.R.
HEALTH SCIENCE

Introduction
In football, like in other sports, the physical performance and role of the referees is as important as the players competing in the pitch. Nowadays, football, being one of the most common sports in the world, is physically highly demanding. Therefore the referees should cope with this high intensity in order to take control of the game and especially in order to make correct decisions. The purpose of this study was to evaluate the balance, flexibility and explosive strength of elite referees and assistant referees in Turkish Republic of Northern Cyprus.
Metods
Fifty active referees and assistant referees of the Referees' Association Board of the Cyprus Turkish Football Association, participated in this study. Subjects were apprised of the procedure, possible risks, and benefits of participation in the study prior to giving informed consent. The sociodemographic features of the participants were recorded. Their flexibility was evaluated by using the 'sit and reach' test. Their static balance was evaluated by using the 'stork balance' test. The 'forty meter sprint' test is used as well to assess the explosive strength.
Results
Twenty referees (age: 35,70±6,72 year, BKI: 24,85±1,97 kg/m2) and thirty assistant referees (yas:31±6,43 year, BKI: 24,77±3,17kg/m2) participated to this study. No significant difference between the referees and the assistant referees in the static balance values and flexibility values was observed (successively P=0,17 and P=0,32). Only in the 'forty meter sprint' test results, significant difference was observed between the referees and the assistant referees (p=0,02).
Discussion
The assistant referee's role has remained fundamentally the same since the beginning of his introduction to the rule of play. It is his duty to assist and advise the referee from the touchline, with a particular focus on specific aspects of the game. That's why he is also known as the linesman. Thanks to his advantageous position in the field, he can decide much more easily than the referee whether the ball has gone out of play. When the whole of the ball has left the field, the linesman raises his flag to signal the need for a throw-in, goal kick or corner kick. Besides, his main duty is to warn the referee by raising his flag when he spots a player in an offside position. Therefore it is not surprising to observe that the explosive strength of the assistant referees is better than the referees. Moreover it is well known that flexibility and balance are important biomotor abilities in football players and in referees and assistant referees as well. The nonsignificant difference between referees and assistant referees in the balance and flexibility abilities can help us to interpret that referees and assistant referees are similar and homogeneous groups.
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14:00 - 15:00

Mini-Orals

MO-PM09 Training and testing: Football

RELATIONSHIPS BETWEEN MATCH STATISTICS AND TEAM'S MATCH PERFORMANCE IN THE GROUP STAGE OF UEFA CHAMPIONS LEAGUE FROM 2009 TO 2017

YI, Q.
TECHNICAL UNIVERSITY OF MADRID

Introduction
The aim of this study was to determine the relationships between the variation of performance-related match events and actions and the team's match performances at the group stage of UEFA Champions League during the past 8 seasons.
Methods
Data of all 1536 matches played at the group stage of UEFA Champions League from 2009 to 2017 were analyzed. Twenty performance-related match events and actions were chosen and the coefficient of variation (CV) of each event and action of each team at each season was calculated. Correlations between points of group stage and CVs were assessed. Moreover, a generalized linear model was employed to identify the linear relationship between the probability of qualifying the knockout stage and CVs. Lastly, teams Barcelona, Bay-

ern Munich and Real Madrid were chosen for a case study to explore which match events and actions contributed to their excellent and stable match performance in the past 8 years. Inferences were made using the non-clinical magnitude-based inferences and evaluated by the smallest worthwhile change.
Results
Analysis showed that for all the teams in the past 8 years, CV of shot(r; ±90% confidence limit(-0.21; ±0.10), shot on target(-0.27; ±0.10), shot from open play(-0.26; ±0.10), shot from counter attack(-0.23; ±0.11),shot from set piece(-0.27; ±0.10), through ball(-0.34; ±0.09), possession(-0.26; ±0.10), corner(-0.22; ±0.10), and aerial success(-0.30; ±0.09) were negatively correlated with the points gained. A two-standard-deviation increased in the CV of Shot, shot on target, shot blocked, shot from open play, shot from set piece, shot from counter attack, corner, pass, through ball, short pass, pass success, possession, aerial success and yellow card, would lead to decreases of the probability of qualification in 28.7%(±90% confidence limit:±10.8), 33.5%(±10.8), 11.1%(±10.4), 32.0%(±10.7), 17.1%(±10.6), 22.5%(±11.1), 16.4%(±10.5), 14.1%(±10.5), 35.3%(±11.0), 12.0%(±11.1), 58.6%(±29.3), 16.0%(±10.4), 28.6%(±11.0) and 12.3%(±10.4), respectively. While a two-standard-deviation increased in the CV of yellow card would bring a 12.3%(±10.4) higher probability of qualification.CV of shot(-0.78;±0.32), shot from open play(-0.85;±0.24), shot from set piece(-0.88;±0.20), offside(-0.61;±0.46) for Barcelona, shot on target(-0.66;±0.43) and possession(-0.60;±0.47) for Bayern Munich and shot on target (-0.63;±0.45) and pass success(-0.59;±0.47) for Real Madrid were negatively correlated with points. CV of aerial success(0.58;±0.48) for Barcelona, corner(0.77;±0.34) and foul (0.63;±0.45) for Bayern Munich and dribble won(0.70;±0.40), pass(0.72;±0.38), cross (0.79;±0.31) and long ball(0.57;±0.49) for Real Madrid possessed positive correlation with points.
Discussion
The analysis of CV of match events and actions of football teams can evaluate the stability of match events and actions of football team in a given time period and they may provide football teams with a better understanding of their game-play style and they could be aware of their own traditional superiority and their weaknesses for a long time.

MATCH OUTCOME, PLAYING POSITIONS AND DISTANCES COVERED AT VARIOUS SPEEDS IN MATCH PLAY BY ELITE GERMAN SOCCER PLAYERS

CHMURA, P.1, KONEFAŁ, M.1, ANDRZEJEWSKI, M.2, KOWALCZUK, E.3, ROKITA, A.1, CHMURA, J.1
UNIVERSITY SCHOOL OF PHYSICAL EDUCATION

Introduction
The study of variables significantly influencing match outcome is one of key issues in contemporary football. The aim of the present study is to examine how various playing positions and match outcome affect the total distance and distances covered in different ranges of intensity by German Bundesliga soccer players.
Methods
Match performance data were collected from 350 soccer players competing in the German Bundesliga during the 2014/2015 domestic season. A total of 4393 individual match observations were undertaken on outfield players. Only data for players completing entire matches were considered. Match observations were made with regard to match outcome: won, drawn, loss. The players were classified into five positional roles: central defenders (CD), full-backs (FB), central midfielders (CM), wide midfielders (WM), and forwards (F). The analysis was carried out using the Impire AG motion analysis system in all 306 Bundesliga matches. The following variables were analyzed: total distance [km] covered, distance [km] covered at intensity ranges of below 11 km/h, 11-14, 14-17, 17-21, 21-24, and above 24 km/h.
Results
The forwards (F) were observed to cover a significantly longer total distance in won matches than in drawn and lost matches ($p \leq 0.05$). The players in all playing positions were shown to cover a significantly longer distance at 11 km/h in won matches and drawn than in lost matches ($p \leq 0.05$). The forwards (F) and wide midfielders (WM) covered significantly longer distances at 21-24 km/h and above 24 km/h in won and drawn matches than in lost matches ($p \leq 0.05$). An inverse relationship was noted for central midfielders (CD) and full-backs (FB) ($p \leq 0.05$).
Discussion
High-intensity and sprinting activities are crucial determinants of match outcome in contemporary football (Haugen et al. 2014). The ability to perform high-intensity exercise with insufficient recovery breaks is an important component of motor preparation of football players (Ingebrigtsen et al. 2015). The results of the present study will enable an optimal and invividualized motion analysis of training accounting for the levels of players' activities in won matches. Moreover, they can be used for individualization training loads of football players with regard to their playing positions and activity profiles.
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Contact
pawel.chmura@awf.wroc.pl

COMPARISION OF MATCH ACTIVITIES OF PROFESSIONAL AND NON-PROFESSIONAL SOCCER REFEREES

JAKOB, S., HARTMANN, U.
UNIVERSITY OF LEIPZIG

Introduction
Because of a higher professionalization and specialization in soccer refereeing a corresponding increase of publications referring referees' performance is available. The activity patterns of professional soccer referees (Rs) in official matches have already been well described. Less research was done with assistant referees (ARs), with female and non-professional match officials. The aim of the present study was to examine the physical performance of non-professional Rs and ARs in comparison with findings in the literature for international professional match officials.
Methods
Ten Rs and 24 ARs (26,5 ± 8,1 yrs, 180,7 ± 7,6 cm, 78,8 ± 8,5 kg) were analysed in 20 official games in German 5th to 8th division. Match total distance (TD) and activity patterns were examined using portable GPS devices (GP Sports SPI Pro X, Canberra Australia, 5Hz). Relative standing time, the amount of walking, jogging and high-speed running were calculated.

Results
Mean TD of Rs and ARs were 9,6 ± 0,7 km and 5,2 ± 0,6 km respectively. The analysis of movement patterns showed that Rs were standing for about 25 % of match time, performed 2,5 km walking and 0,5 km high-speed running. ARs spent about 55 % of match time standing, 1,9 km walking and 0,2 km high-speed running.
Until now 26 articles regarding physical match performance of Rs and eight studies concerning ARs were found. Mean TD of Rs was greater (10,9 ± 1,2 km) than for German non-professionals. ARs in German non-professional leagues also performed less TD than international ARs (6,4 ± 0,7 km). The Rs' relative standing time varied between 11 and 38 % of match time. For ARs slightly smaller amounts of standing (43 and 46 %) were found in the literature. The quota of non-professionals' game activities matched well with the results of professional Danish Rs (Krustrup & Bangsbo, 2001) and ARs (Krustrup et al., 2002).
Discussion
The match performances of non-professional match officials showed less activity concerning smaller TD and an identified higher quota of standing. Nevertheless, huge similarities in the distribution of activity patterns between professional and non-professional Rs and ARs were found. For further research more female related aspects would be necessary because there was only one study particularly examining female referees.
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Contact
simone.jakob@uni-leipzig.de

RARITY AND DIFFICULTY OF BALL POSSESSION SKILL IN SOCCER.

YAMADA, H., KITAMURA, Y.
BIWAKO SEIKEI SPORT COLLEGE

Introduction
Ball possession skill in soccer is needed to dominate the game and get a goal. Many teams is using a "rondo" training to develop the skill. There should be many skills, however, the detail has not been unveiled yet. Yamada et al. (2016) tried to investigate the skill's difficulties with questionnaire, and they were not clarified in detail. Therefore, we verified to the rarity and difficulty of ball possession skills with performance analysis.
Methods
24 male college soccer players (21.5±4.2 yrs.) performed a "rondo" which means 4 v 2 ball possession training on 5.5m by 12m rectangle coat for 10 minutes. 957 passes were recorded on a video device and counted while playing back the video. They were classified into 8 skills and evaluated that were success or failure by 3 men licensed soccer coach. Pass success rates, pass rarities, and these product as difficulties were calculated. Intra- and inter-rater reliability were verified with kappa coefficient.
Results
Intra- and inter-rater reliability were over 0.80. Pass success rates in each item were recorded from 71.1% to 95.1 % and pass rarities were from 3.8% to 57.9%. It was clarified that outside pass performed with the worst success rate (71.1%) and open pass were the rarest (3.8%) and the most difficult (3.5%).
Discussion
It was shown that the high rarity skills have not always have low success rate because skillful player performed precisely and timely. Difficult skills were shown rarely with high accuracy, on the other hand, general skills were shown many opportunities with low accuracy. It suggested that accurate skill and timely decision making in playing a rondo were important to success (Di Bernardo, 2014). The Difficulty meant a successful pass appearance probability in a rondo and that can be useful indicator as a scale for the skill and the player's level.
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Contact
yamada-hi@bss.ac.jp

SPEED OF THOUGHT AND SPEED OF FEET: THE ANALYSIS OF PERCEPTUAL-COGNITIVE EXPERTISE AND SPRINT ABILITY IN ACADEMY FOOTBALL PLAYERS

KELLY, A. L., WILLIAMS, C. A., WILSON, M.
UNIVERSITY OF EXETER

Introduction
Elite youth football players can be differentiated from their non-elite counterparts by their speed of thought through perceptual-cognitive expertise (PCE; Ward & Williams, 2003), and speed of feet through sprint ability (Vaeyens et al., 2006). However, the degree to which both are required to excel in a football Academy is unknown. Therefore, the aim of this study was to investigate PCE and sprint ability as contributing factors to coach ratings in an Academy environment within the Foundation Development Phase (FDP; U9 to 11's) and the Youth Development Phase (YDP; U12 to 16's).
Methods
This study measured 98 outfield Academy players (FDP n=40; YDP n=58). Film based simulations were used to examine PCE (Belling et al., 2014). Forty-five clips were stopped at different phases ('at' and 'post' execution), with players selecting the best outcome from the options available. The 30 m sprint test was used to observe sprint ability at 0–10, 10–30, and 0–30 m. Two professional coaches from each age group ranked their players from top to bottom in relation to current ability from a holistic perspective. This created a linear classification with a group of 'high-performers' (top third) and 'low-performers' (bottom third). Results were standardised using z-scores and the assumptions were tested using a two-tailed independent samples t-test.
Results

In both the FDP and YDP, high-performers were significantly faster than low-performers for the 0–30 and 10–30 m sprints ($p<0.05$), with high-performers in the YDP also significantly faster in the 0–10 m sprint ($p<0.05$). Additionally, high-performers made significantly more accurate decisions in the PCE 'post' test in the FDP ($p<0.05$) and the PCE 'at' test in the YDP ($p<0.05$).
Discussion
Sprint ability and PCE were significant discriminators of coaches' ratings within the FDP and YDP, although specific differences between phases were found. The PCE results appear to differ between the two phases, arguably due to the increased difficulty of the 'at' clips, which separate YDP players, compared to the 'post' clips, which separate FDP players. Additionally, 0–10 m sprint ability only separated YDP players, highlighting the greater physical importance in that phase with this additional significance. Consequently, this reveals high-performers demonstrate superior PCE and quicker sprint ability in both Academy age phases, with PCE and 0–10 m sprint ability improving with age. Thus, supports the importance of speed of thought and speed of feet in Academy football within the FDP and YDP.
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Contact
adam.kelly@ecfc.co.uk

BEGINNER GOALKEEPERS' PREDICTIONS IN THE FAKE MOVEMENTS OF THE PENALTY KICK

INOUE, Y.1, WAKISAKA, A.1
1: OSAKA INSTITUTE OF TECHNOLOGY

Introduction
It's important which direction a goalkeeper expect the ball to fly to. A few studies reported that he was gazing at the movement of the kicker's lower body in order to judge the direction of the goal kick (Piras et al., 2011). However there are a few studies that examined what part of a kicker's movement he gazed for the kicker's fake kick. The purpose of this study is to examine by analyzing eye movements how a beginner goalkeeper expects the direction the ball for the fake penalty kick.
Methods
Sixteen college students participated in the experiments. The participants were instructed to observe a series of penalty kick movements of an avatar on the monitor and predict the direction (right or left) where a penalty kick flies by the time his foot contacts a ball. Eight kinds of virtual realty animations with the different directions of his head, shoulders and pivot foot of the final kicking action were used as experimental conditions. Participants did a set of eight trails on 8 conditions 15 times. The correct answer rate of the prediction of 15 trials on each condition was calculated. How the eyes move and where they gaze were recorded with an eye tracker. The electroencephalogram (EEG) was recorded at Cz.
Results
The correct answer rate of the prediction was low on the condition that the shoulders and the pivot foot are different from the head in the direction. By contrast, the correct answer rate was high on the condition that the directions of the head, shoulders and foot are the same. In wrong answers, the gaze tended not to be fixed in the head and the pivot foot, but in correct answers, the gaze tended to keep concentrating on the pivot foot. As more trails, the gaze tended to concentrate on the pivot foot of the avatar. Readiness potential occurred at 0.9 seconds before judgment, and its amplitude tended to be larger on the condition that the correct answer rate was low.
Discussion
The experiment showed that predictions might be difficult to make on the condition that the directions of the shoulder and foot are different from that of the head. In other words, that the direction of the head was important in the feint kick, because the gaze did not focus on the head and the pivot foot in wrong answers. Since the amplitude of readiness potential was larger on the condition that the direction of the head is different from those of the shoulders and the foot, it might be more difficult to judge the direction of the penalty kick on this condition.
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Contact
yumiko.inoue@oit.ac.jp

LOCATION AND OCCURRENCE OF JOINT AND MUSCULOSKELETAL PAIN IN FOOTBALL GOALKEEPERS DURING A 5-DAY TRAINING CAMP

KAWCZYNSKI, A., MURACKI, J., BOUDREAU, S.A.
UNIVERSITY OF PHYSICAL EDUCATION (WROCLAW,POLAND), AALBORG UNIVERSITY (DENMARK)

Introduction
Sustaining acute injuries during pre-training and training seasons are common for football players and goalkeepers (Di Salvo et al., 2008). The purpose of this study was to gain insight on where and how often acute injuries are sustained during a 5-day training camp in adolescent football goalkeepers. The aim was to determine the locations, area and extent of joint and muscle pain in addition to pain resulting from direct impact either from the ball, goal-post, ground or player.
Methods
Twenty-three football goalkeepers (21 male) were recruited from a local five-full day training camp. Daily training consisted of two 1.5 hour sessions including typical goalkeeper activity. Shortly following the second training session participants were asked to indicate joint pain (JOP), on-going continuous muscle pain (CMP), movement provoked muscle pain (MPP) and pain specifically associated with an impact to the body (IMP). By way of pain mapping players provided detailed expressions of JOP, CMP, MPP and IMP by drawing on an anterior, posterior and lateral (left and right) views of high-resolution 3D body charts. Location and area (expressed as pixels) were extracted using the pain mapping software Navigate Pain (Boudreau et al., 2015). Non-parametric analyses were used to contrast and assess changes in the total pain extent within and between joint and musculoskeletal pain during training.
Results
Preliminary analysis revealed that 70% of all players reported CMP and 56% reported IMP whereas MPP and JOP were reported less often (30%). CMP and MPP were expressed in thighs and chest muscles as viewed from the anterior charts and shoulder area and

gluteus muscles as viewed from the posterior charts. JOP appeared in the fingers, knee and ankles and IMP on the lateral side of the thighs and hips and elbows. The extent of JOP, CMP, MPP and IMP (expressed as the area under the curve of pain area across days) differed (X2=13.2, p=0.004) with mean rank pain extent score of 61.96 for CMP, 45.36 for IMP, 41.13 for HMP and 37.52 for JOP. The extent of CMP was greater than IMP (p = 0.005) and JOP (p = 0.025).
Discussion
Adolescent goalkeepers reported pain in the thighs, hips, knees, ankles, chest and elbows with continuous pain as being the most common and widespread complaint. Delayed onset muscle soreness likely contributes to continuous and movement provoked pain however notable reports of joint and impact pain, even bruising, appeared more randomly.
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Contact
kawczynski.a@gmail.com

AN INVESTIGATION INTO ENGLISH PREMIER LEAGUE YOUTH SOCCER MAXIMUM VOLUNTARY FORCE, EFFECTS OF CURRENT TRAINING PRACTICES AND COMPARISON TO A CONTROL GROUP.

BROWNLEE, T., O'BOYLE, A., MORGANS, R., MORTON, J., ERSKINE, R., DRUST, B.
LIVERPOOL JOHN MOORES UNIVERSITY

Introduction
The aim of the present study was to record normative isometric maximum voluntary force (MVF) data at baseline and after an 8 week period using the isometric mid-thigh pull (IMTP) from players throughout an English Premier League academy compared against a maturation-matched control group.
Methods
One-hundred-and-fifty-five elite participants from an English Premier League academy's Under 9 to Under 21 age groups and ninety-three, maturation-, weight- and height-matched control participants performed the IMTP. Allometrically scaled (peak force divided by body mass^0.66) MVF was recorded. Performance tests were analysed in three maturity groups based on years from/to age of predicted peak height velocity (PHV): pre-PHV, mid-PHV, and post- PHV in elites and controls. One-hundred-and-forty-two and sixty-two of the elite and control cohorts respectively were retested 8 weeks later.
Results
A small increase was seen in isometric MVF in the elites compared to control group at baseline (118.29 ± 13.47 compared to 109.69 ± 17.00 N, P < 0.001) though no difference was seen between groups after 8 wks (P = 0.167).
Discussion
The small difference in baseline MVF suggests the training undertaken by this elite group is insufficient to elicit optimal muscular strength adaptation.

A COMPARATIVE STUDY OF HEART RATE AND BLOOD LACTATE RESPONSE OF JUNIOR AND SENIOR FOOTBALL MID-FIELDERS DURING PRACTICE FOOTBALL MATCH PLAY

GUPTA, S., GOSWAMI, A.
UNIVERSITY OF WEST INDIES, CAVE HILL

Introduction
Movement intensities of footballers during a match play depend on level of the tournament, importance of the match, match strategies, position of play, and skill, motivation and fitness of the players. Lactate level in blood (La) and heart rate (HR) of the players are reliable indicators of the intensity and contribution of aerobic-anerobic energy systems in the match. The aim of this study was to analyse the HR and La of junior and senior midfield football players during practice matches to compare cardiovascular stress and contribution of anerobic glycolytic system.
Methods
This study was conducted on 9 midfield junior (<20 y) and 8 midfield senior Indian footballers during 3 practice matches played between junior and senior teams while attending precompetition selection camps. During match play, HR was recorded at an interval of 5 s, however, blood samples were collected at 15th, 30th, 45th, 60th, 75th, and 90th minutes of the game. HRs at two ventilatory thresholds during incremental exercise on treadmill were used as the markers of intensity zones – low, moderate, and high.
Results
Results of the three matches were 1-0, 4-1, and 3-1 in favour of seniors. Age and VO2max of the juniors and seniors were 18.4±1.4 vs 28.6±4.2 y and, 53.9±4.8 vs 55.5±6.7 ml/kg/min. Low intensity zone corresponds up to 156 bpm (79.9% HRmax) in juniors and 143 bpm (75.1% HRmax) in seniors; moderate intensity corresponds to 157-178 bpm (80.4–91.2% HRmax) in juniors and 144–170 bpm (75.6–89.3% HRmax) in seniors and high intensity, >178 bpm (>91.2% HRmax) in juniors and >170 bpm (>89.3% HRmax) in seniors. During match play, Mean HR in juniors and seniors were 82.6 and 82.2% of HRmax respectively. Percentage of time spent by the juniors and seniors in three intensity zones were 48.1 vs 52.4% (low), 30.4 vs 23% (medium), and 21.5 vs 24.6% (high). Blood lactate levels in juniors and seniors were 6.4±1.7 vs 7.2±3.2 (15th min), 7.4±2.3 vs 7.8±2.7 (30th min), 6.6±1.1 vs 7.8±2.1 (45th min), 6.4±2.3 vs 6.9±3.1 (60th min), 5.9±2.2 vs 6.8±1.8 (75th min), and 6.5±1.7 vs 7.2±2.1 mmol/L (90th min).
Discussion
The study concludes that (1) overall cardiovascular load in junior and senior midfield footballers during match play do not differ (2) seniors play longer time in both the low and high intensity zones but less time in medium intensity zone in comparison to juniors, (3) lactate concentration rises higher in seniors probably because of more dependence on anerobic glycolysis than juniors and (4) results may act as useful tool for trainers in managing the training process.
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Contact
subirgupta@yahoo.com

Mini-Orals

MO-PM20 Nutrition: mixed session

FAVORABLE SUPPLEMENTAL FOODS DURING SUMMER TRAINING CAMP IN ADOLESCENT JAPANESE RUGBY PLAYERS

NAGAYAMA, C., ISHIHARA, M., IWAMI, M., TOBINA, T.
UNIVERSITY OF NAGASAKI

Introduction
Intake of adequate and well-balanced nutrients helps athletes achieve optimal performance. However, studies have found that daily athletic training attenuates appetite and food intake after high-intensity exercise, and have shown deficient carbohydrate intake among athletes (Vatansever et al., 2011, Lun et al. 2009). The present study investigated favorable foods for supplemental nutrition during summer training camp in adolescent Japanese rugby players.
Methods
Thirty-eight male rugby players (age, 17±1 years) who took part in a 3-day camp participated in the study. They were offered 10 types of supplemental food (e.g., beverages, fruit, and rice balls) four times a day, and permitted to eat as much as they wanted. The amount of supplemental food consumed was counted for each participant. Other foods consumed were also measured by weighted food record. Energy and macronutrient intakes were calculated using the items' nutritional fact labels and the standard tables of food composition in Japan. Body composition was also measured each morning.
Results
Energy intake from supplemental foods significantly decreased on the second (1,189±586 kcal) and third (1,267±600 kcal) days compared with the first (1,677±693 kcal; $p<0.05$), and carbohydrate intake significantly decreased on the second day (270±139 g) compared with the first (341±144 g; $p<0.05$). However, apple juice, orange juice, and energy jelly intake accounted for 80% of supplemental carbohydrate intake. The amount of the foods did not decrease. Although carbohydrate intake was 8.9±2.3 g/kg/day, 39% of participants had insufficient intake (8-12 g/kg/day, ACSM, 2016). On average, participants ingested 48% of their carbohydrates through supplemental foods. The amount of carbohydrate intake correlated with body weight change ($r=0.454$; $p<0.01$).
Discussion
Participants training in a hot and humid environment (WBGT: 27-32). Westerterp et al. (1997) showed increased thirst and fluid intake after exercise (or sauna). Thus, preference for liquid foods might be due to dehydration and/or hyperthermia; obviously, fruit juices and energy jelly were easier to ingest than cut fruit and rice balls. We can conclude that energy and carbohydrate intakes were insufficient among the studied population; however, appropriate food selection, including items such as fruit juice and energy jelly, aids sufficient intake of carbohydrates. This may resultantly prevent weight reduction.
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Contact
B3211026@gmail.com

PROJECT SPRAOI: NUTRITIONAL KNOWLEDGE AND DIETARY PATTERNS OF CORK SCHOOL CHILDREN

MERROTSY, A.1, MCCARTHY, A.L.2, FLACK, J.1, COPPINGER, T.1
CORK INSTITUTE OF TECHNOLOGY

Introduction
In Ireland, no research to date has objectively investigated both the dietary knowledge and behaviours of Cork school children; factors which are known contributors to Ireland's childhood obesity epidemic (1).
Methods
Participants (n=101) were senior infants (n = 49, age 5.9 ± 0.6 years) and fourth class (n = 52, age 9.8 ± 0.5) children. Dietary intake was assessed using a 4-day estimated Food Diary (2) and data was exported to Diet Plan 7 software (Forestfield Software, 2015) for analysis. Children also completed a validated nutritional knowledge questionnaire (3) adapted for an Irish setting, to examine their knowledge of healthy foods and the Irish Food Pyramid (4). To curtail the effect of potential misreporting in the present study, all macro nutrients were expressed as a proportion of energy consumed.
Results
Results revealed that children's diets failed to meet recommen-dations for fibre (5), calcium (6), iron (6), fruits and vegetables (6) and were above the recommend daily intake for fat (5), saturated fat (5) and number of unhealthy treats(4).Out of a possible maximum score of 15, mean scores for the nutritional knowledge questionnaire were 9.25 ±2.15 and 9.4 ±2.16 (6 year old boys and girls) and 12.96 ±1.26 and 12.29 ±1.44 (10 year old boys and girls).
Conclusion
Cork school children's diets are lacking in vital nutrients that are essential for healthy growth and development (4). They are also high in saturated fat, which is a key contributor to childhood obesity, high cholesterol and heart disease risk (7). The mean scores for nutritional knowledge for 10 year olds are similar to those found by Gower et al. (2010) (3).
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EFFECT OF XBOX ACTIVE VIDEO GAME AND NUTRITION EDUCATION INTERVENTION ON WEIGHT CONTROL, FITNESS AND THE CARDIOVASCULAR DISEASE RISK FACTORS IN OVERWEIGHT AND OBESE ADOLESCENT GIRL

LEE, P.C., CHANG, W.H.

KAOHSIUNG MEDICAL UNIVERSITY

Introduction
The cause of obesity and overweight is an energy imbalance between calories consumed and calories expended. In addition to increasing physical activity and decreasing sedentary lifestyle, active video gaming might have an additional effect on the prevention of obesity [1]. Therefore, the aim of this study was to evaluate the effects of XBOX active video game (Just Dance 2016) and nutrition education on weight control, fitness and the cardiovascular disease risk factors in overweight and obese among high school female students.
Methods
This study was a parallel trial of 10-week period, 24 healthy, overweight or obese (BMI ≥ 22.7 – 32 kg/m2) subjects aged 15-18y, were randomly assigned into three groups: the active video game group (XBOX, n=8), the nutrition education group (Diet, n=8) and combined group (XD, n=8). XBOX group played XBOX One game (Just Dance 2016) 3 d/wk for at least 50 min. Diet group were provided five nutrition education classes and used 24-hour recalls to assess the dietary behaviors of food intake. XD group were observed the combination effects. Anthropometric measurements, fitness and fasting blood samples were measured at 0,5 and 10 weeks.
Results
In XBOX group, the body weight (69.9 ± 10.8 vs. 68 ± 11.6 kg), BMI (26.7 ± 3.6 vs. 26 ± 4 kg/m2), body fat percentage (40.4 ± 3.3 vs. 37.8 ± 4.3 %) and WHR (0.91 ± 0.06 vs. 0.88 ± 0.03) were significantly decreased after 10 weeks of the exercise gaming, and were significantly improved in the fitness (cardiorespiratory, flexibility and agility). In Diet group, there were significant improvement in the fitness (cardiorespiratory) and decrease in WHR (0.88 ± 0.05 vs. 0.3 ± 0.03) after 10 weeks intervention. In XD group, there were significant decreased in body weight (69.5 ± 9.7 vs. 66.7 ± 9.6 kg), BMI (26.6 ± 2.4 vs. 25.4 ± 2.4 kg/m2), WHR (0.89 ± 0.05 vs. 0.86 ± 0.03), TC (173.8 ± 24 vs. 163 ± 27.8 mg/dl), LDL-C (114.9 ± 28.8 vs. 104.9 ± 31.2 mg/dl), and were significant improvement in the fitness (cardiorespiratory and agility).
Discussion
It was demonstrated that combination with active video game and diet control could help improve body composition, decrease hyperlipidemia, enhance cardiorespiratory fitness and weight control in overweight or obese among high school female students , just as the other age groups in previous studies [2-3]. Exergames can be regarded as an enjoyable, motivating, and effective physical activity tool. Therefore, we suggest that active video game can be an effective technological tool for weight loss in sedentary group.
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A POST WORKOUT BLEND BEEF AND WHEY PROTEIN BEVARAGE PROMOTE BETTER BODY COMPOSITION CHANGES THAN INGESTED ONLY CARBOHYDRATE IN CROSS COUNTRY RUNNING ATHLETES.

MORENO-PÉREZ, D.1, LARROSA, M.1, PÉREZ RUIZ, M.1, CENTENO, A.1, ESTEVE-LANAO, J.1, LARUMBE-ZABALA, E.2, NACLERIO, F.3

EUROPEAN UNIVERSITY OF MADRID

Introduction
Both, Beef and Whey are high-quality protein sources with a very similar amino acid composition to that found in the skeletal muscle. Although whey contains higher concentrations of branched-chain amino acid (BCAA), specifically leucine, which is essential for supporting muscle protein synthesis after exercise, beef provides higher amounts of iron, zinc, vitamin B12, and essential fatty acid. The current study aimed at comparing the impact of an oral supplementation with a blend hydrolysate beef and protein, or only carbohydrate on body composition, and iron status in males endurance athletes.
Methods
Thirty-six resistance-trained males (32.23±9.77 years) were randomly assigned to the following 2 groups: blend beef and whey protein (BW n=13), or non-protein isoenergetic carbohydrate (maltodextrin; CHO n=13). All had to take 25 g of the proteins or carbohydrate, mixed with 300 ml plain water, once a day (immediately after the workout or during breakfast for the non-training days) over an entire 12-week training period. Body composition, measured by dual-energy X-ray absorptiometry (DEXA; Lunar Prodigy, GEMedical Systems, Bucks, UK) hemoglobin (g/dl), hematocrit (%), and ferritin concentration (ng/mL)were assessed before and after the intervention.
Results

Only the BW group showed significant decreases in body mass (p=0.011), total and relative fat mass (p=0.002) and trunk fat (p=0.024). Significant increases have been also observed in total (p=0.001) and relative (p=0.039) fat-free mass as well as the total fat measured for both right (p=0.13) and left leg (p=0.05). No changes were observed for the haematological variabls.
Discussion
Results demonstrated that ingesting a post work beef and whey protein beverage containing 25 g of proteins (10g of beef hydrolysed, and 15 g of whey isolate from Crown® Sport Nutrition, Spain) promote body mass decrease based on trunk fat mass reduction and increase of the lower body fat-free mass in trained males cross country runners. The present results support previous positive effects of protein supplementation at promoting positive body composition outcomes in endurance athletes.
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GLUCOSE-FRUCTOSE INGESTION INTERACT WITH MUSCLE LACTATE METABOLISM DURING TRAINING SESSIONS

ROSSET, R., EGLI, L., CROS, J., SCHNEITER, P., TAPPY, L., LECOULTRE, V.

UNIVERSITY OF LAUSANNE

Introduction
Blood lactate is generally considered to originate mainly from muscle glycolysis during exercise, and to be either used in other muscle fibers (lactate shuttle) or recycled back to glucose in the liver. These exchanges are modulated by exercise intensity and training. Ingestion of fructose-containing drinks stimulates lactate production and release from the liver during exercise, and that fructose-derived lactate is subsequently used as an energy substrate by muscle. How this hepatomuscular lactate shuttle affects muscle lactate production remains however unknown. In this work, we assessed whether ingestion of fructose-containing drinks alters the effects of exercise intensity and exercise training on lactate concentrations.
Methods
Sixteen sedentary healthy males participated in a training program during which they performed 15 sessions of continuous cycling exercise over 3 weeks (one 60 min session per day, five day a week). Training intensities were set as 50% (sessions 1-3), 55% (sessions 4-6), 60% (sessions 7-9) and 65% (sessions 10-12) of baseline VO2max. Subjects ingested either glucose-fructose drinks (GF group, n=8, three times 163 mL containing 16 g glucose and 10 g fructose) or plain water (C group, n=8, three times 163 mL), at -20, 0 and 20 min relative to the onset of exercise. Blood lactate concentration was measured at 0, 30 and 60 min exercise at the earlobe.
Results
Subjects anthropometrics, baseline VO2max (44.3±2.3 vs. 46.4±2.2 mL/kg/min) and training workloads were all similar in GF and C (all P=N.S.). Blood lactate at time 0 (i.e. postprandial but pre-exercise) was higher in GF than C, consistently across consecutive training days (mean: 1.7±0.2 vs. 1.1±0.1 mmol/L; group effect: P<0.01; sessions effect: P=0.62). During exercise, mean lactate concentrations were increased by exercise intensity significantly in C: 1.4±0.2, 2.0±0.3, 2.2±0.3 and 2.8±0.4 mmol/L at 50%, 55%, 60% and 65% VO2max (intensity effect: P<0.01). In GF in contrast, this effect was blunted: 1.6±0.2, 1.9±0.3, 1.9±0.3 and 2.3±0.4 mmol/L at 50%, 55%, 60% and 65% VO2max (group x intensity effect: P=0.02).
Discussion
Our data are consistent with muscle glycolysis being the main source of plasma lactate when subjects drink water during exercise, and with net muscle lactate efflux increasing at higher exercise intensities. In contrast, consumption of glucose-fructose drinks alters this effect. We postulate that, in these conditions, plasma lactate originating from splanchnic organs may impair muscle lactate efflux.
Contact
Robin.Rosset@unil.ch

EFFECT OF ERGOGENIC AID HMB SUPPLEMENT ON SIGNAL TRANSDUCTION PATHWAY DURING OSTEOCLAST PRECURSOR FORMATION

WEI HUNG1. CHIH-LI LIN2, HORNG-CHIANG HSU3, YAO-HUNG KUO1, CHEN-KANG CHANG1

1 NATIONAL TAIWAN UNIVERSITY OF SPORT, TAICHUNG, TAIWAN. 2 CHUNG SHAN MEDICAL UNIVERSITY, TAICHUNG, TAIWAN. 3 DEPARTMENT OF ORTHOPEDICS, CHINA MEDICAL UNIVERSITY HOSPITAL, TAICHUNG, TAIWAN

Introduction
Dietary supplement of β-hydroxy-β-methylbutyrate (HMB) had been proven not only increase muscle mass but also increase the mass, density and architectures of skeleton tissues in animal studies. Previous results of our research indicated that HMB supplement not only increase bone formation but also inhibited bone resorption, possibly through inhibition of NF-κB pathway. In the following study, we discovered that HMB supplement inhibited osteoclastogenesis through suppress receptor activator of nuclear factor κB (RANK) expression. However, downstream signal transducer of RANK, NFATc1, remain unaffected and downstream regulate protein DC-STAMP induced by NFATc1 remain stable as well. Such results indicated that inhibition effect of HMB supplement on osteoclastogenesis might work in inducing expression of RANK and consequently lead to reduce formation of osteoclast precursors. Evidences from literature review indicate that TNF-a not only promote leukocyte proliferation but also play a key role in osteoclastogenesis through inducing RANK expression. However, TNF-a has been proven to cross-talk with IGF-1 and be inhibited, while previous results of other researchers indicated that HMB supplement increase IGF-1 level. Therefore, hypothesis of present study was HMB supplement inhibit osteoclastogenesis through affecting cross-talk mechanism of TNF-a with IGF-1.
Methods
12 healthy college males aged 20-22 years old were volunteers for present study. All subjects ingested 3 grams of HMB daily in the early morning for 13 days and daily diets were recorded. Fasting blood samples were collected through venipuncture on 1, 2, 3, 6, 9, 12 hours after HMB supplement in day 1 and following sampling were early morning of day 2, 3, 4, 6, 8, 11 and 14. Plasma TNF-a and IGF-1 level were analyzed by ELISA kit. RANK and DC-STAMP expression on PBMC surface were analyzed by Flow cytometer.
Results

Serum TNF-a level decreased 2 hours after HMB supplement. Accompany with decrementation of TNF-a, RANK expression was decreased as well with 4 hours of delay onset.
Discussion
Such results perfectly match the foundation hypothesis of present study. However, IGF-1 level were decreased as RANK expression were inhibited at 6 hours after the supplement and remain lower through the entire supplement period which does not match the cross-talking hypothesis described earlier. Results of present study indicated that HMB supplement downregulate the expression of RANK but mechanism of inhibition effect require further study to evidence.
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EFFECTS OF RAPID WEIGHT LOSS ON PERFORMANCE IN RUNNERS.

TAKAE, R.1, KISHITA, K.1, HATAMOTO, Y.1, YAMAMOTO, T.1, YAMAGUCHI, M.1, TANAKA, H.1
1: FUKUOKA UNIVERSITY

Introduction
It is well known that in endurance sports like marathon running, characteristics such as maximal oxygen uptake (VO2max), lactate threshold, and the energy cost of running play key roles in performance. Previous study showed that body fat percentage and running speed during training were correlated in a highly significant manner (Joyner MJ et al., 2008). Thus, weight loss and body fat loss may improve endurance performance in runners. The purpose of this study was to determine whether rapid weight loss improves performance in runners.
Method
Six male runners participated in a weight-loss program for 7 days (Age: 20.5±1.4y, Height: 168.3±3.1cm, Weight: 56.8±6.9kg, Body Mass Index: 20.1±2.0kg/m2). Participants were asked to increase their physical activity and provided with hypoenergetic diets (energy intake (EI): ideal body weight ×20kcal/day) with high-protein content (1.5g/kg/day). Before and after the weight loss, runners participated in a 5000m time trial and their body composition was measured. Body composition was assessed using underwater weighing and stable isotope dilution methods. Fat-free dry solids (FFDS), total body water (TBW) and fat mass (FM) were estimated with Siri's three-component model. Fat free mass (FFM) was the sum of TBW and FFDS. Total energy expenditure (TEE) was measured using doubly labeled water.
Results
TEE was 3088±481kcal/day and EI was 1174±0 kcal/day during weight-loss program . Body weight (BW), FFDS and FM significantly decreased (BW: -2.0±0.8kg, p=0.001, FFDS: -1.0±0.5 p=0.006, FM: -2.9±1.3kg p=0.003), and TBW had a tendency to increase after the weight-loss program (1.9±2.0kg, p=0.07). FFM did not increase during the study. Average 5000m time trial were faster after the weight loss than before.
Discussion
The energy restriction elicited negative energy balance (-1914kcal/day). Therefore, body weight decreased after 7 days. Total negative energy balance corresponded to approximately 14000kcal. This negative energy balance was corresponded to approximately 2kg body fat mass. In contrast, FFM did not decrease. Previous study indicated that consuming dietary protein at 1.6 g/kg/day may be an effective nutritional strategy to protect FFM in response to unavoidable or planned dietary and/or physical activity-induced weight loss (Pasiakos M,2013). In this study the protein intake was 1.9±0.2g/kg/day. We concluded that our weight-loss program may be effective for body weight loss and maintaining FFM, improving performance in runners.
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Contact
lrietty.tl@gmail.com.

INFLUENCE OF A 9-DAY MIMIC OF PALEOLITHIC LIFESTYLE ON METABOLIC GLUCOSE UTILIZATION IN YOUNG HEALTHY PEOPLE

HOLDER, J., KRUSCHE T., PLATEN P.
RUHR-UNIVERSITY BOCHUM

Introduction
The skeletal muscle disposes a large portion of an oral glucose load through both non oxidative and oxidative mechanisms [1]. Short-term exposure to a high-fat, low-carbohydrate diet reduced whole body glucose disposal during an oral glucose tolerance test (OGTT) in aerobically trained men [2]. But the influence of imitation a Paleolithic lifestyle (PL) including Paleolithic diet (PD) and movement pattern (PM) on glucose utilization (GU) in healthy young people is unclear so far. Aim of the study was to investigate the influence of a short-term PL on GU.
Methods
11 young healthy subjects (m: 7; f: 4; age: 21.7 ± 1.4 yrs; BMI: 23.9 ± 2.3 kg/m²) took part in a 9-day intervention imitating PL in the Polish Carpathians. The subjects were high in fat, low in carb with approximately daily intake of 1700 kcal through self-acquired food. GU was tested in a sober state for two times, in a rest state and after physical activity (treadmill stage test), one before the intervention (M1) and one at the end of the intervention (M2) using a previous validated PD conform analogical OGTT with honey (OHTT; 111.4 g honey + 500 ml H2O). Capillary glucose blood level GLU was analyzed once before the OHTT (T0) and every 10 min after OHTT-application until 120 min (T10 - T120).
Results
Absolute mean GLU peaked significantly higher during rest conditions at T30 (7.9%) and T40 (13.7%) on M2 compared to M1 (M1, T30: 151.5 ± 20.5, T40: 138.8 ± 25.4; M2, T30: 164.6 ± 25.6, T40: 161.0 ± 24.1 mg/dl, $p < .05$, respectively). Relative mean GLU increased during rest conditions at T30, T40, and T50 (M1, T30: 72.6 ± 18.8, T40: 60.0 ± 26.3, T50: 49.5 ± 30.0; M2, T30: 85.0 ± 25.4, T40: 81.4 ± 25.7, T50: 68.1 ± 29.3 mg/dl, $p < .05$, respectively) and after physical activity at T10, T20, T30, and T40 (M1, T10: 4.6 ± 16.9, T20: 26.1 ± 25.7, T30: 38.9

± 28.6, T40: 31.2 ± 37.3; M2, T10: 15.1 ± 10.7, T20: 45.0 ± 17.4, T30: 58.4 ± 18.5, T40: 51.0 ± 27.2 mg/dl, p < .05, respectively) on M2 compared to M1. Comparative analyses of further GLU showed no more differences between M1 and M2.
Discussion
We found that short-term imitation of a PL in young, healthy subjects leads to slight changes in glucose metabolism. Decreased GU at rest and after exercise indicates a shift towards more fat and less carbohydrate oxidation to provide energy to skeletal muscle. Therefore, our results are in line with studies demonstration these effects following low carbohydrate diets, both at rest and during exercise [3]. Further studies recommend exploring long-term effects of mimic a PL.
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EFFECTS OF A 10 DAY PALEOLITHIC DIET INTERVENTION ON SUBMAXIMAL ENDURANCE PERFORMANCE AND ENERGY SUPPLY IN RECREATIONAL ATHLETES

BROECKL, F., GOSMANN, C., KOENEKAMP, M., WOLFGRAMM, T., KRUSCHE, T., PLATEN, P.
RUHR-UNIVERSITÄT BOCHUM

Introduction
A balanced and high-energy diet is a key factor for health and performance in sports. Public believe is that a Paleolithic diet (PD) might lead to benefits in health and athletic ability. A PD is often characterized as a ketogenic diet. Studies demonstrate that a low carb, high fat diet (LCHF) during training periods lead to changes in muscular metabolism causing impairments in race performance in elite athletes [1]. In this context, the aim of the study was to analyze the muscular energy supply and biomarkers of endurance performance during submaximal exercise after a PD combined with everyday hiking.
Methods
13 sports science students (m = 11, w = 2; 21.9 ± 2.2 yrs, BMI = 22.8 ± 2.2; VO2max = 55.2 ± 5.9 ml/kg/min) went on a Paleolithic hiking trip in a rural area of Swedish Lapland for 10 days. PD on the trip was high in fat and included LCHF nutrients like nuts, seeds, eggs and meat. Oxygen intake (VO2), respiration exchange ratio (RER), heart rate (HR), and blood lactate concentrations (LA) were determined using a submaximal incremental step test. In addition, body mass (BM) was measured before each step test. The step test was carried out 7 days before the trip (d-7) and on the last intervention day (d11). Comparative analysis focuses on differences before (rest conditions: RC) and during (at step frequency of Stage 4: SF4, 102 bpm, respectively) the step test. Data is presented as mean ± SD.
Results
BM, HR and RER decreased significantly at RC and SF4 (BM: d-7: 74.5±10.1, d11: 70.4±9.2, p<.001, respectively; HR: RC: d-7: 87±15, d11: 68±9, SF4: d-7: 159±16, d11: 151±16 bpm; RER: RC: d-7: 0.80±0.06, d+1: 0.74±0.03, SF4: d-7: 0.88±0.05, d11: 0.83±0.04, p<.05, respectively). LA increased at RC, but remained unchanged at SF4 (RC: d-7: 0.80±0.15, d11: 1.05±0.27, p<.05; SF4: d-7: 1.94±1.09, d11: 2.19±1.30 mmol/l, p>.05, respectively). VO2 stayed unaffected at both levels (RC: d-7: 485±192, d11: 438±111, SF4: d-7: 2126±474, d11: 2239±472 ml/min, respectively).
Conclusion
Our data was in line with previous studies into LCHF interventions [1, 2]. The results show that the ketogenic PD directed the muscular energy supply towards fat oxidation which became obvious by lower RERs, HRs [3] and a tendency of higher VO2. We found no additional benefits following PD during submaximal exercise. Missing shifts in submaximal LA at the same endurance load, suggests no improvements from a PD on endurance performance. The question whether or not a PD effects race performance is still open. However, our sample did not show any negative effect undergoing a short-term PD.
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Mini-Orals

MO-PM11 Training and testing in various sports 2

SEASONAL VARIATIONS OF LACTATE KINETICS IN ALPINE SKIERS

HOSHINO, H., TSUNODA, K., MAUNE, J., SASAKI, T.
HOKUSEI GAKUEN UNIVERSITY

Introduction
Lactic acid metabolism is widely known as the lactic acid shuttle.Lactic acid metabolism is under the control of the mono carboxylate transporters MCT1 and MCT2. Blood lactic acid is mediated by the action of MCT 4 which carries muscle made lactic acid to the blood, then MCT 1 transports it to the mitochondria. In this study, blood lactic acid metabolism (i.e., the activities of MCT 4 and MCT 1 were examined to evaluate whether or not blood lactic acid metabolism varies significantly during training sessions pre and post competitive season, and to see if this could be applied to designing conditioning regimen for alpine skiers.
Methods
Subjects were six male alpine skiers: age: 19.0 ± 1.4 years old, height: 167 ± 2.8cm, weight: 69.8 ± 6.0kg. Currently the best single test for determining physical characteristics suitable for alpine skiing is the 90 second squat rebound jump exercise developed by Bosco (BRJ); it is a good indicator of the competitive level of an alpine racer, though the Wingate test is also widely used. Both Wingate and BRJ tests were performed over 90 seconds following which subjects rested in the sitting position and lactate levels were assayed every minute for 30 minutes by fingertip puncture using a lactate Pro 2 (Arkray Co., Ltd.). For the Wingate test resistance was set at 7.5% load per body weight. Both tests were performed prior to and after the alpine competitive season.
Results

The maximum lactic acid values following each of the two test types were assayed pre and post competitive season. In the BRJ test, there was a significant increase, while there was no change observed for the Wingate 90 test. Furthermore, when comparing lactate kinetics after exercise, no change in time constant was observed in both tests. The most obvious result is that there was no apparent change in lactate levels pre and post season assayed by both the Wingate and BRJ. This is only based on a sample size of six subjects, but the BRJ looks more promising for finding possible seasonal changes.
Discussion
Though not significant in this study, it would be expected that the BRJ would be more affected by the musculature developed over an alpine competitive season as the BRJ examines muscle groups specifically used by alpine skiers, while the Wingate test is more an indicator of general fitness. Put another way, stretch shortening is required for alpine skiing which the BRJ tests. Peak lactate levels relate to lactate kinetics, but are much more easily obtained. However, in this study of only six subjects, peak lactate levels did not yield any significant findings. However, since the time constants did not vary between seasonal measurements for both of the test types, it may be that the obtained values reflect each athlete's MCT1 kinetics.
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Contact
h-hoshi@hokusei.ac.jp

ENERGY COST OF CONSTANT-SPEED RUNNING – ARE THERE DIFFERENCES REGARDING TYPE OF SPORT AND SEX?

VENZKE, J., PLATEN, P.

RUHR-UNIVERSITY BOCHUM

Introduction
The energy costs (EC) of constant-speed running over a wide range of inclines are well known. However there is deficit on estimating EC on a flat terrain concerning various velocities. A mathematical approach [1] can be used to calculate metabolic load during accelerated running which assumed the EC on constant-speed running to be 3.6 J x kg-1 x m-1. However recent data shows that this value needs to be individualized on type of sport, person and possibly sex [2]. The aim of this study was to measure an exact value for soccer and field-hockey players.
Methods
Eighty-three elite soccer and field-hockey players, male (24.6±4.0 y, 181.4±6.6 cm, 77.9±7.7 kg, 57.8±4.8 ml x min-1 x kg-1; n = 63) and female (24.6±3.6 y, 168.1±5.1 cm, 63.5±6.2 kg, 51.5±3.6 ml x min-1 x kg-1; n =20), participated in a multi-stage treadmill test starting at 8 km/h (t = 3 min; stage = 2km/h) to exhaustion. Simultaneously V'O2 was measured via spirometry technology for an accurate calculation of EC for each stage. Test and retest (n =11) were compared, as well as differences in gender, velocity and type of sport. Data was analyzed Pearsons chi-squared test and a multivariate analysis of variances.
Results
EC for running at a constant speed was significantly higher in male soccer players (4.25 J x kg-1 x m-1) compared to male hockey players (4.12 J x kg-1 x m-1) for all velocities except 12 and 18 km/h ($p < 0.05$). In contrast to female hockey players (4.02 J x kg-1 x m-1) EC were significantly higher for male hockey athletes ($p < 0.05$) for velocities of 8, 10 and 12 km/h. Test and retest showed no difference ($p > 0.05$) nor correlation ($p > 0.05$).
Discussion
The data showed that an individual value for type of sport and sex seems to be necessary for a better understanding of the EC regarding the analyzed team sports. Also the more exact knowledge of the EC of constant-speed running may lead to benefits for steady state endurance training concerning nutrient uptake, regeneration management and training load. Nevertheless, more adaptions of the formula are necessary for an estimation of the real EC in team sports. Yet for a detailed analysis of the EC in soccer and hockey games further studies are needed – including an analysis of the EC for team sport specific movement patterns and changes of direction.
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Contact
jan.venzke@rub.de

POSTURAL EVALUATION IN A GROUP OF ARTISTIC ROLLER SKATING ATHLETES.

NART, A.,1,3, ROSSATO, M.2, MORO, T.1,4

1UNIVERSITY OF PADOVA-ITALY, 3UNIVERSITY OF URBINO-ITALY,4UTMB GALVESTON TEXAS, 2SCIENTIFIC ADVISOR OF POSTURAL EQUIPE ACADEMY, VENEZIA ITALY

Introduction
Figure skating is a blend of technical and artistic skills, where having a good postural control is essential to ensure the success of technical difficulties, such as spins and jumps. Postural control is the set of mechanisms and regulations depending on tonic postural system which is divided in exteroceptive and proprioceptive components and guarantees static and dynamic balance. The purpose of this study was to determine if there is a difference on postural strategies implemented by a group of artistic roller skating athletes compare with average population.
Methods
The study was conducted on 16 female athletes in artistic roller skating (RG) aged between 10 and 15 years belonging to the same group of competitive spirit. We compared stabilometric measurements in upright stance (Open and Closed Eyes) with static mode controls (CG) as described in the guidelines Rossato et al (2013).
Results
"Area" parameter in RG (=269.08) is lower at Open Eyes than CG (=351.31), while at Closed Eyes in RG (=307.69) is lower than CG (=523); Xm in RG is a negative value (Xm<0) in both conditions (Open and Closed Eyes) and Ym in RG identified positive values (Ym>0) than CG at Open and Closed Eyes; LFS (Open and Closed Eyes) in RG is greater than 1 (LFS>1). The Romberg's quotient is less than the average of CG

(QRBG<139) and the inter-correlation between right and left in RG is projected to +1 (IntCorGD=0.64 in Open Eyes; IntCorGD in Closed Eyes=0.73).
Discussion
RG shows good stability (lower "Area" parameter compared to the average of CG), however, RG shows a continuous search for stability in Open and Closed Eyes (LFS>1). We noticed that RG search the stability on the left side and forward (Xm and Ym parameters) and this is a characteristic of the disciplines. Considering Romberg's quotient (QRBG=123.22), we note that the RG shows great inexperience by proprioceptive (QRBG0 in Open and Closed Eyes) indicates that the RG has good coordination between right and left sides, this is also justified by observing the discipline practiced. In conclusion athletes have good coordination but not the same stability. In future could be to include a proprioceptive program (foot and visual receptor) to stimulate the tonic postural system to greater stability and performance.
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SHAKING THE HANDS ENHANCES INTERMITTENT HANDGRIP PERFORMANCE IN ROCK CLIMBERS

BALAS, J., MICHAILOV, M., GILES, D., KODEJSKA, J., PANACKOVA, M., FRYER, S.
FACULTY OF PHYSICAL EDUCATION AND SPORT

Introduction
This study aimed to evaluate the effect of hand shaking during recovery phases of intermittent testing on the time–force characteristics of performance and muscle oxygenation during intermittent testing in rock climbers.
Methods
Twenty-two participants undertook two finger flexor endurance tests at 60% of their maximal voluntary contraction until failure. Performances of two intermittent contractions, each with a different recovery strategy, were analysed by time-force parameters and near infrared spectroscopy.
Results
The recovery with shaking of the forearm beside the body led to a significantly greater intermittent test time (↑ 22%, $P < 0.05$), force-time integral (↑ 28%, $P < 0.05$) and faster muscle re-oxygenation (↑ 32%, $P < 0.05$), when compared to the hand over hold condition. The increase of performance was related to climbing discipline end experience (advanced lead climbers ↑ 38%; advanced boulderers ↑ 24%; lower grade climbers ↑ 4%).
Discussion
Both the type of recovery and climbing discipline determined muscle re-oxygenation and intermittent performance in rock climbers.

INFLUENCE OF BELAY TRAINING WITH A GRIGRI ON EXECUTION OF THE BRAKE HAND PRINCIPLE IN UNEXPERIENCED BELAYERS

MATIAS SANTOS, V.M.1, CRONRATH, M.1, KRUSCHE, T.2
RUHR UNIVERSITÄT BOCHUM

Introduction
Most climbing accidents occur during lead climbing [Woollings et al. 2015]. This regards 78% of climbing accidents in Germany, with the belayer often being responsible for causal mistakes [Hummel et al. 2014]. Violating the brake hand principle (BHP) is one of the most frequent operating errors [Funk et al. 2013]. Explorative studies confirmed an attenuated prevalence of accidents regarding the use of half automatic devices, such as the Grigri in inexperienced belayers [Funk et al. 2013, Hellberg et al. 2014]. However, to our understanding derived from practical application, an exclusive learning with Grigri intensifies the individual error rates (ER) in BHP. The purpose of the study was to compare the effects of exclusive belay training with Grigri with exclusive belay training with Tube to analyze the effects on ER in BHP.
Methods
22 healthy subjects (m = 15; w = 7; age = 24.0 ± 4.0 yrs) were randomized into an experimental group (EG: n = 10) and a control group (CG: n = 12). The EG was trained in belaying the lead climber 1.5 hrs with a Grigri and the CG was trained in belaying the lead climber 1.5 hrs with a Tube. One week subsequent to training, participants conducted a filmed test session in which each belayed the lead climber with a Grigri for 5.5 min. during fall training. The ER (number of faults) in the BHP was evaluated by five independent persons using the video recordings. Significance was set at 0.05.
Results
Number of faults in the BHP was significantly higher in EG compared to CG (mean ± SD: EG: 2.7 ± 2.0 faults; CG: 0.8 ± 0.7 faults; $p < 0.01$).
Discussion
A belay training using only a Grigri does not sufficiently teach the hand brake principle. Procedural memory is created through procedural learning [Andersen eta l. 2015]. A deficit in procedural memory regarding BHP is likely attributed to the absence of negative feedback throughout errors in preceded simulations. Therefore, the behaviour during belaying cannot completely be related to the theoretical knowledge but rather to the experience on belaying [Cronrath et al. 2010]. The Grigri is considered a very safe belaying device and brakes the rope in almost every situation. At the same time, it does not teach the BHP, but this is acceptable as long as the subjects always belay with a Grigri.To use another belaying device a specific belaying training with the new belaying device is required.
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Contact
victor.matiassantos@rub.de

SPEED AND JUMPING HEIGHT DISCRIMINATE BETWEEN FENCERS OF DIFFERENT PERFORMANCE LEVEL, AGE AND SEX, BUT NOT BETWEEN ELITE FENCERS

MENTZ, L., WEICHENBERGER, M., LIU, Y., STEINACKER, J.M.

UNIVERSITY HOSPITAL OF ULM

Introduction
Fencing performance does not only depend on the fencers' and his opponents' skills, but also on physiological determinants like speed, endurance, and strength. Fencing specific tests are necessary to evaluate current performance levels and to optimize preparation for competitions. The aim of this study was to compare and evaluate physiological determinants of fencers of different sex, performance level, and age.
Methods
A standardized test protocol was used from 2008 – 2016, combined with a routine medical examination of German elite and sub-elite fencers at the Olympic (Tauberbischofsheim) and National Training Center (Heidenheim). The test protocol consisted of vertical jump tests to evaluate strength and power of the lower extremities. Namely squat and countermovement jump (Quattro Jump Forceplate, Kister, NY, USA) and drop jump (Opto Jump, Microgate, BZ, It). A fencing specific 5m sprint, a 3m sprint with fencing specific footwork and tests of change of direction speed were recorded (Brower Timing, UT, USA).). Athletes were ranked elite or sub-elite according to the German classification system. Furthermore athletes were divided into age groups according to the International fencing federation: cadettes, junieurs, senieurs.
Results
In total, 1068 tests were conducted (603 male). Male fencers performed significantly better than females ($p<0.001$ throughout all tests). In line with the current literature male fencers performed ~11% better in speed tests and ~26 % better in jump tests than female. Elite fencers of each sex performed significantly better than sub-elite fencers ($p<0.001$ throughout all tests). In general, older age groups performed better, but age did not influence results within elite level. Furthermore, no significant correlation between performance and physiological characteristics was found within the elite level for the male athletes.
Discussion
The results show that strength and unspecific and fencing specific speed differs between fencers of different performance level, age and sex. Noteworthy, a third of the fencers of the elite group belonged to the senieurs and the majority were junieur fencers. There is an age difference between the elite and sub-elite group. But notably, elite fencers of the junieur or cadette age group performed significantly better than sub-elite fencers of the same age. It is reasonable to assess physiological determinants of performance in fencers, since they discriminate between fencers of different age groups and performance level. However, they do not discriminate between fencers of elite level. Obviously, other determinants of fencing performance (e.g. tactics and technique) are of higher importance on this level as basic determinants like speed and strength have reached a certain threshold. We will aim to provide concrete data for these threshold values in future analyses.

ACTN3 GENE POLYMORPHISM MAY PLAY A ROLE TO DETERMINE THE DURATION OF JUDO MATCHES

ITAKA, T.1, TOMIZAWA, Y.2, AGEMIZU, K.3, INOUE, K.3, ARUGA, S.4, MACHIDA, S.1

1: JUNTENDO UNIVERSITY, 2: TOKAI UNIVERSITY, 3: TOKAI UNIVERSITY, 4: TOKAI UNIVERSITY

Introduction
Alpha-actinin-3 (ACTN3) and angiotensin-converting enzyme (ACE) gene polymorphisms are reportedly related to the duration of track and field and swimming. Variability in the duration of judo matches may be related to genetic factors. We hypothesized that these gene polymorphisms are associated with the duration of judo matches. The purpose of this study was to investigate the association between the ACTN3 and ACE gene polymorphisms and the duration of judo matches.
Methods
The study included 129 Japanese male athletes in the judo club of T University. The frequencies of the ACTN3 R577X (rs1815739) and ACE ID (rs1799752) gene polymorphisms were determined with PCR or PCR-RFLP analysis. We also surveyed 13 judo instructors about the duration of the judo matches of the subjects. We then divided the subjects into a fast match-decider group and a slow match-decider group. These groups were compared the genotype frequencies by using the chi-square test.
Results
Genotype frequencies of ACTN3 gene polymorphism, but not ACE gene polymorphism, were significantly different between fast match-decider (RR genotype 65.4%, RX genotype 34.6% and XX genotype 0.0%) and slow match-decider (RR genotype 4.8%, RX genotype 23.8% and XX genotype 71.4%) in winning matches. In case of losing matches, genotype frequencies of ACTN3 and ACE gene polymorphism was not significant differences.
Discussion
Many previous studies reported that ACTN3 gene polymorphism is associated with muscle power and strength. Judo athletes at the top college levels may unconsciously be using optimum strategies that best suit their physical features. Genetic factors may be worth considering when selecting strategies and tactics for judo instruction in the future. The duration of judo matches depends on the skill level of opponents, kumite, and differences in weight class and conditioning, and we did not control for these variables in our analysis. The ACTN3 gene polymorphism, but not the ACE gene polymorphism, may be associated with the duration of judo matches.
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INTENSITY AND ENERGY EXPENDITURE DURING THE DAKAR RALLY SPECIAL STAGE AT ALTITUDE 3500 - 4200 METERS IN ELITE OFF-ROAD RALLY ATHLETES.

ZELENKOVA, I.1, ZOTKIN, S.1

RUSSIAN OLYMPIC COMMITTEE INNOVATION CENTER

Introduction
The Dakar rally requires an athlete to cross off-road sections with different terrain like dunes, rocks and others and cover the distance at each stage from 200 to 900 kilometers (during two weeks). The number of calories that are used during this race depends on different

factors like gender, body composition, the course, and technical problems during the race, environmental factors, efficiency and time to complete the stage.
Methods
Seven male athletes (176(174-182) cm, 85 (76-88) kg, body mass index 23 (22-24) kg/m2, 35 (29-41) y) members of the Russian rally truck team participated in the study. Each subject underwent body mass composition analysis (InBody), incremental test for anaerobic threshold (AT) determination with lactate sampling (Biosen, C-Line) on a stationary cycle ergometer (Ergoselect 200) before the race. Heart rate (HR) data and energy expenditure were measured during the special stage (Firstbeat, Bodyguard) that took place between 3.500 and 4.200 m in altitude. Measurement were taken night before the stage 7 at Dakar rally 2016, during connection (304 km) and during special stage (295km). For rating sample characteristics, median and interquartile dispersion was used. Pearson correlation was used to determine the statistical dependence between two variables.
Methods
Power at AT were 2.2(2-2.36) W/kg, muscle mass 41(35-42) kg, fat mass 11(7-12) kg. Total energy expenditure (TEE) in athletes during the measurement (17h) were 2993(2354-4077) ccal, with 970(861-1239) ccal of carbohydrates and 2023(1493-2838) ccal of fats. Average HR 96(86-99) bpm, maximal HR 150(138-161) bpm, minimal 68(62-72) bpm. Correlation between TEE and mean HR during the measurement were found (r=0.8) and with muscle mass (r=0.7). Also correlation were observed between carbohydrate expenditure and maximal HR (r=0.9), correlation between fat expenditure and mean HR (r=0.8). The relationship between fat mass and minimal HR were observed (r=0.9) and negative relationship with maximal HR (r=-0.8). Relationship between muscle mass and fat expenditure also were found (r=0.75).
Discussion
Monitoring exercise intensity and energy expenditure at altitude helps us to describe with data physiological characteristics of off-road rally athletes —provide considerable information on the energy demands of this type of athletes for nutritionist and coaches.

PHYSICAL FITNESS OF WOMEN AND THEIR ABILITY TO PASS AN ENTRY LEVEL FIRE FIGHTER TEST

WILLIFORD, H.1, JOHNSON, B.1, REILLY, E.1, ALLEGRO, D.1, SCHAEFER, G.1, ESCO, M.2, NICKERSON, B.3
AUBURN UNIVERSITY MONTGOMERY

Introduction
The purpose of this study was to determine the relationship between physical fitness/performance and the ability of women to pass an entry level fire fighter fitness test. Fire departments in the United States and Canada require passing the Candidate Physical Ability Test (CPAT) in order to be employed as a firefighter. Departments often have a difficult time recruiting women who can meet the entry level standards. The CPAT consists of the following test items: stair climb, ladder raise and extension, hose drag, equipment carry, forcible entry, search, rescue drag, and ceiling pull. The stair climb section of the CPAT is the first test item and one of the most difficult to pass. The test consists of the following: stepping on a Stairmaster at a cadence of 60 steps/min for 3 min, while wearing a 22.72 kg weighted vest, with an additional load of 11.36 kg added to the shoulders. The added weight simulates the weight of the firefighters Turnout Gear and emergency response apparel.
Methods
Fifteen women (24.9 ± 3.2 years; 167.0 ± 5.1 cm; 66.4 ± 9.2 kg) were recruited and tested on the following variables: cardiovascular fitness (VO2 peak), muscular strength and endurance (leg press, push-ups, pull-ups), anaerobic power (Wingate Test), and body composition (BOD POD). In addition relative and absolute strength and endurance values were calculated (based on body weight and LBM). Statistical analysis consisted of means and standard deviations for each variable (mean ± SD). Pearson correlation coefficients (r), and stepwise multiple regression analysis (R2) were performed evaluating the relationships between each of the independent variables with the stair climb time the dependent variable.
Results
The following values represent the correlations between each independent variable and CPAT Stair Climb time (sec): percent body fat (r = -0.780, p = 0.000), VO2 max (r = 0.750, p = .0001), pushups (r = 0.805, p = .000), pullups (r = 0.419, p = 0.029), leg press (r = 0.499, p = 0.029,) peak power (r = 0.565, p = 0.014), lean body mass (r = 0.559, p = 0.015), relative pushups (r = 0.814. p = 0.000), relative pullups (r = 0.460, p = 0.460). The stepwise multiple regression analysis, produced the following equation: Step time = 0.539 + (4.379 * relative pushups), R2 = .708, F = 31.77, p = .000.
Discussion
This investigation found significant relationships in a number of fitness variables and the CPAT test. The stepwise multiple regression analysis indicates that relative upper body strength, as measured by LBM and the number of pushups, was the single best predictor of a woman's ability to perform the CPAT stair climb test. Women seeking to become a firefighter should be aware of the importance of upper body strength and its relationship to meeting entry level fire fighter standards.
Contact
hwillifo@aum.edu

Mini-Orals

MO-PM21 Injuries: risk factors, incidence and prevention

NEUROMUSCULAR ADAPTATIONS TO EXERCISE-BASED INJURY PREVENTION PROGRAMMES IN YOUTH SPORTS: A SYSTEMATIC REVIEW WITH META-ANALYSIS OF RANDOMISED CONTROLLED TRIALS

FAUDE, O.1, RÖSSLER, R.1, PETUSHEK, E.2, ROTH, R.1, ZAHNER, L.1, DONATH, L.1
1 UNIVERSITY OF BASEL, SWITZERLAND; 2 MICHIGAN STATE UNIVERSITY, USA

Introduction
Exercise-based injury prevention programmes (IPP) can reduce injury rate by up to 50% in youth sport (Rössler et al., 2014). Multimodal IPP include, for instance, balance, power, and agility exercises. Our systematic review and meta-analysis aimed to evaluate the effects of multimodal IPP on neuromuscular performance in youth sports.
Methods

A systematic literature search including selected search terms related to youth sports, injury prevention, and neuromuscular performance was conducted. Inclusion criteria were: (i) the study was a (cluster-)RCT, (ii) healthy participants, up to 20 years of age and involved in organised sport, (iii) the study included an intervention arm performing a multimodal IPP as well as a control arm following a common training regime, and (iv) at least one neuromuscular performance parameter (balance, power, sprint, agility) was assessed. In addition, we analysed effects on football specific skills (i.e. slalom dribbling). Data were analysed using random effects inverse-variance models.
Results
In total, 17 RCTs (comprising 779 participants) were analysed. Nine studies included only males, and 6 only females. In 82% of all comparisons, football players were analysed (with basketball, futsal, Gaelic football and hurling being the remaining sports). The average age of the study populations ranged from 10 y up to 19 y and the level of play from recreational to professional. Intervention duration ranged from 4 to 20 weeks with a total of 12 to 50 training sessions.
We observed large effects in favor of the IPP group for sprint acceleration (standardized mean difference (SMD) 0.92; 95%CI 0.30,1.54) and agility (SMD 0.90; 95%CI 0.33,1.47), and medium effects for straight sprint speed (SMD 0.74; 95%CI 0.31,1.17), static (SMD 0.60; 95%CI 0.07,1.12) and dynamic (SMD 0.54; 95%CI 0.22,0.85) balance as well as slalom dribbling (SMD 0.54; 95%CI 0.08,1.00), compared to the control group. A small effect was present for vertical jump height (SMD 0.39; 95%CI 0.15,0.62).
Discussion
Multimodal IPP beneficially affect several neuromuscular performance measures. Particularly, acceleration and agility were relevantly improved. This might be important as situations with sudden de- and accelerations and changes in movement direction comprise a high risk of injury. The general improvements in neuromuscular performance may support the wide-spread implementation and dissemination of IPP.
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Contact
oliver.faude@unibas.ch

ANTHROPOMETRIC VARIABLES AS RISK FACTORS FOR MUSCULOSKELETAL INJURIES IN ATHLETES AND MILITARY PERSONNEL: A SYSTEMATIC REVIEW

MELLONI, M.
UNIVERSIDADE ESTADUAL DE CAMPINAS

Introduction
The objective is to determine whether an anthropometric profile can be considered as a risk factor for musculoskeletal injuries in professional athletes and militaries.
Methods
Systematic reviews of the PubMed-Medline and Embase databases were performed. Studies were included if they were published in the last ten years. Two independent researchers performed the selection. The methodological quality of the studies was assessed as the evidence level.
Results
A total of 747 articles were identified, and 39 studies were included. Ten studies were of military personnel, and 29 were of athletes. There were 18 anthropometric variables studied. A high level of evidence indicates that a higher body mass index is risk factor for ankle sprains and for injuries in general, and that higher weight is a risk factor for ankle sprains.
Discussion
Although a higher body mass index and a higher weight were identified as risk factors, high quality studies focusing on different variables, such as skin mass and fat mass, are still needed; these studies may reveal a more definitive connection between obesity and injuries.

WHAT IS A RISK FACTOR FOR ANKLE SPRAIN?

TAKESHI, T.1, AKITO, T.1, SHIRO, S.1,2, JUNKO, W.1, YUKA, T.1, KEITA, N.1, YASUTAKA, O.1, SATORU, N.1
1:NISHIKAWA ORTHOPAEDIC CLINIC (CHIBA, JAPAN), 2:DEPARTMENT OF ORTHOPAEDIC SURGERY, GRADUATE SCHOOL OF MEDICINE, CHIBA UNIVERSITY (CHIBA, JAPAN)

Introduction
Although some sequelae, such as restriction of ankle dorsiflexion and mechanical or functional ankle instability, have been reported, risk factors on physical activity and condition for recurrent ankle sprain are unknown. The purpose of this study was to determine risk factors for ankle sprain from physical assessment data obtained prior to the start of the high school basketball league season.
Methods
The physical activity and condition of 37 high school basketball players (74 legs) were assessed in April prior to the start of the basketball league. The research period was two years. The basketball team's trainer recorded the number of lateral ankle sprains that occurred each year. Physical activity and condition were as follows: body mass index, ratio of arch height, modified leg heel angle, length from lateral malleolus to base of 5th metatarsal bone with inversion stress (lateral length), thumb to wall distance, velocity from centre of pressure analysis and Karlsson ankle function score as self-reported ankle function. A previous history of ankle surgery or ankle fracture excluded individuals from analysis. Informed consent was obtained before participating. Multiple risk factors were evaluated using Cox regression analysis for ankle sprain-related variables.
Results
Seven ankle sprains occurred during the study period (incidence, 0.61 per 1000 athlete-exposures). There were no differences in body mass index, ratio of arch height, modified leg heel angle, thumb to wall distance, velocity from centre of pressure analysis, or Karlsson ankle function score. Lateral length was the only significant risk factor (mean±SD : ankle sprain 7.2±0.8cm, not ankle sprain 6.6±1.0cm) for ankle sprain in the multiple Cox regression analysis (RR, 2.45; 95% CI, 0.9–6.4; p = 0.06).
Discussion
Lateral length is defined as the length from the lateral malleolus to the base of the 5th metatarsal bone with inversion stress applied manually to the subject's ankle position. Although this study indicated that joint laxity might be a risk factor for ankle sprain, the relationship between them is still controversial. To clarify this relationship, further studies are required in the future.
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Contact
toyookat@naoso.com

INJURIES IN 17-19 YEAR-OLD MALE AMATEUR SOCCER PLAYERS

ACKERMANN, S.1, HENKE, T.2, BLOCH, W.1
1: GERMAN SPORTS UNIVERSITY OF COLOGNE, 2: RUHR-UNIVERSITY BOCHUM

Introduction
There is only a small body of literature regarding injuries in male youth amateur soccer players. Yet such information is fundamental for effective prevention. The goal was the analysis of injury patterns among 17-19 year old male amateur soccer players, and the comparison with adult male amateur and professional players.
Methods
Questionnaire-based retrospective observational cohort study from August 30, 2014 to January 04, 2016. Participants were recruited from 20 clubs of four regional soccer leagues, representing the fifth and sixth highest level of performance for this age group. 301 players who competed in one of these leagues during the season 2015/16 were included. Players were instructed to fill out one general questionnaire to collect anthropometric data and sports specific data such as exposure and experience as player, plus, in case of at least one injury during the relevant period of time, one additional questionnaire per injury to collect data regarding, inter alia, injured body parts, cause of injury, incidence and time loss.
Results
205 players sustained 253 injuries. The incidence was 12.9 injuries per 1,000h of competition exposure and 1.1 injuries per 1,000h of practice and friendly games. 82.9% of injuries were located at the lower extremity. Ligaments were injured most frequently (23.3%). 32.0% of all injuries could be graded as severe, 45.1% as moderate, followed by 15.4% mild and 4.7% minimal injuries as defined by Fuller et al. (2006). Physical contact caused injuries most frequently (30.4%), followed by landings (12.9%).
Discussion
Injury incidences in male youth amateur soccer were lower, while the portion of severe and moderate injuries were higher than in studies researching professional soccer. The allocation of injuries was similar to findings in professional and adult amateur soccer. There already exist validated injury prevention programs. While most players and staff think of injury prevention as very important (O'Brien et al. 2016a,b), specific knowledge about and implementation of these prevention programs is very low (O'Brien et al. 2016a; Orr et al., 2013). Although physical contact is cross-study the most important cause of soccer injuries, existing prevention programs almost entirely focus on non-contact injuries. Players ought to be educated about and inspired to use the existing prevention programs, and interventions preventing injuries through physical contact should be developed and validated.
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Contact
stefan.ackermann1994@gmx.de

THE EFFICACY OF INJURY PREVENTION WARM-UP PROGRAM FOR WOMEN HANDBALL PLAYERS

MASHIMO, S.1,2, WARASHINA, Y.1, FONG, D.T.2, SHIRAKI, H.1
1: UNIVERSITY OF THUKUBA (JAPAN), 2: LOUGHBOROUGH UNIVERSITY (UNITED KINGDOM)

Introduction
Handball has a high incidence of injury and pain, especially in women's handball (Mashimo et al., 2016). There are existing programs for injury prevention, but they mainly focus on knee and ankle joints. Some studies report that injuries and pains occur in not only lower extremity but also trunk and upper extremity (Olsen et al., 2006; Langevoort et al., 2007). To prevent them, program of injury prevention that contains whole body exercises is needed. Therefore, the aim of this study was to evaluate the efficacy of a modified warm-up prevention program that contains whole body exercises.
Methods
The incidence of injury and pain were evaluated in 10 elite handball players during 2012-13 season (control period; CP) and 12 players during 2015-16 season (intervention period; IP). A warm-up program was consisted of lower extremity, trunk and upper extremity exercises and it was done at the beginning of every ball training session. Chi-square analysis was used to compare the rate ratio (RR) between the two periods (CP vs IP). Rate ratios are presented with 95% confidence intervals (CI).
Results
There were 23 injuries (3.3 injuries/1000 player hours) during CP and 15 injuries (2.1 injuries/1000 player hours) during IP (RR, 0.62; CI, 0.32-1.18; P=0.14). 20 injuries during CP and 11 injuries during IP were recorded in lower extremity (RR, 0.52; CI, 0.25-1.09; P=0.08). One trunk injury occurred during only CP. Two injuries during CP and four injuries during IP were upper extremity injuries (RR, 1.89; CI, 0.35-10.33; P=0.46). On the other hand, there were 2241 pains (325.5 pains/1000 player hours) during CP and 1147 pains (157.6 pains/1000 player hours) during IP (RR, 0.48; CI, 0.45-0.52; P=0.00). 1539 pains during CP and 575 pains during IP were lower extremity pains (RR, 0.35; CI, 0.32-0.39; P=0.00), 276 pains and 251 pains were trunk pains (RR, 0.86; CI, 0.73-1.02; P=0.00) and 426 pains and 321 pains were upper extremity pains respectively (RR, 0.71; CI, 0.62-0.82; P=0.00).
Discussion
Although there was a trend of reduction in the number of injuries during the two seasons, it was not statistically significant. However, we found that whole body prevention program could prevent pains, particularly lower and upper extremity. Further study is needed to investigate the relationship between injury and pain occurrences.
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Contact
Sonoko Mashimo (mashi.0306@gmail.com)

MUSCLE INJURIES AT DIFFERENT AGES IN AMATEUR FOOTBALL PLAYERS

FERRARI, P., ASSISI, E., SPIRIDONOVA, M., RESNYAK, S.
HEALTHCARE COMPANY IN SOUTH TYROL, BOLZANO, ITALY

Introduction
Muscle injuries is one of the most studied subjects in professional football players. Despite this, researches on amateur football players on this arguments are few, particularly the possible differences in youth (YA) and adult (AA) amateur football players. The aim of this study was to evaluate the injuries, particularly the muscle injury in YA and AA and the possible risk factors
Methods
We distribuited a questionnaire to YA and AA, they were instructed to fill it out, in which were requested the basic charateristics of the player (age, weight, height, role) and the injury history of the previous year. Furthermore, was asked if playing football generally causes them significant physical fatigue or emotional stress. We considered YAs who were under 20 years old
Results
1276 (891 YA) amateur players partecipated and they had 457 injuries in total. Muscle injuries were the most common (32,3%). AA had a higher number of injuried players and traumatic head injuries compared to YA. However there was no difference in muscle injured players. We excluded subjects who had injuries apart muscle problem, as possible altering factor when we made a regression logistic test. We considered age, BMI, years of playing, physical fatigue, emotional stress and role as possible determinat factors and as outcome the muscle injury in the two groups. An advanced age is associated to muscle injury in both AA and YA, but also physical fatigue and role is associated in YA.
Discussion
Amateur football players are the higher percentage of football players but they had not been studied a lot. In our research 27% had an injury and muscle lesions were the most common. Although the number of injured players are greater in the AA, there were no differences in muscle injured players between AA and YA, an equal and important problem in two different kind of players.

VIDEO ANALYSIS OF TACKLING SITUATION IN WHICH CERVICAL INJURIES HAPPENED

SUZUKI, K.1,2, NAGAI, S.3, FURUKAWA, T.1, IWAI, K.2, MIYAKAWA, S.1, TAKEMURA, M.1
1. UNIVERSITY OF TSUKUBA, 2. IBARAKI PREFECTURAL UNIVERSITY OF HEALTH SCIENCES, 3. TSUKUBA INTERNATIONAL UNIVERSITY

Introduction
Cervical injuries are very common in collision sports. Although the incidence of spinal cord injury tends to reduce, minor to moderate cervical injuries, such as cervical sprain and burner syndrome, have been kept high prevalence in rugby. Cervical injuries were commonly caused by tackling. Therefore, tackling characteristics have relationship with tackle outcome and cervical injuries sustained. The purpose of this study was to clarify the tackling characteristics for the players which sustained cervical injuries by tackling.
Methods
We extracted tackling situations causing cervical injuries from video records of the twenty-six matches in Japanese collegiate rugby union. In addition, we identified the tackling situation before the cervical injuries happened in the same match video records by the tacklers, who sustained cervical injuries. We coded all tackling situations according tackling characteristics related to tackle outcome, whether tackles were succeeded or not, and injury happened. All tackling situations were divided into two groups as a function of tackle outcome and cervical injuries happened. The relationship between cervical injuries happened or tackle outcome and tackling characteristics was analyzed by the chi-square test, and then the statistical significance of cells in the tables was examined using residual analysis.
Results
122 tackling situations were identified from twenty-six match video records, including twenty tackles causing cervical injuries. The chi-square test and residual analysis revealed that when tacklers contacted the trunk region of ball-carrier, tacklers contacted ball-carrier by their head/neck, tackler's heads were placed in front of ball-carrier, or tacklers didn't use their arm, tacklers were more likely to be failed and sustained cervical injuries ($p < 0.05$). Conversely, when tacklers contacted the chest region of ball-carrier, tackle's heads were placed in the rear of ball-carrier, or tacklers used their arm, tacklers were more likely to be succeeded and prevented cervical injuries ($p < 0.05$).
Discussion
We clarify the tackling characteristics which the players sustained cervical injuries by tackling. In particular, if tacklers contact the chest region of ball-carrier, or their heads are placed in the rear of ball-carrier, tackles are likely to be success and to prevent cervical injuries. We propose that the coaches highlight the effective and safety tackling characteristics for the body region of ball-carrier and their head placement during tackle.
Contact
Keita Suzuki (suzukike@ipu.ac.jp)

HEAD INJURIES IN PROFESSIONAL MALE FOOTBALL – LOWER INCIDENCE RATES AFTER ALTERATION OF A RULE

BEAUDOUIN, F.1, AUS DER FÜNTEN, K.1, TRÖß, T.1, REINSBERGER, C.2, MEYER, T.1
SAARLAND UNIVERSITY1; UNIVERSITY OF PADERBORN2

Introduction
Although the incidence of head injuries in football is relatively low in comparison to high risk sports, absolute numbers are considerable because of its high popularity and the large number of players. In 2006, a rule was altered (red card in case of intentional elbow to head contact) to reduce head injuries. This study provides a description of head injury mechanisms and examines the effect of the rule change.
Methods
A retrospective analysis of injury incidence rates and injury mechanisms of head injuries was conducted comprising seasons 2000/01–2012/13. Head injuries were identified by a structured search in the German football magazine "kicker Sportmagazin". The injury mechanisms were analysed from video recordings by two different investigators (Donaldson et al., 2013; Fuller et al., 2005). Injury incidence

rates (IR) and 95% confidence intervals (95% CI) as well as incidence rate ratios (IRR) to assess differences before and after the rule change were calculated.
Results
356 head injuries were recorded (IR 2.22 (95% CI, 2.00-2.46) per 1000 match hours). Contact with another player was the most frequent cause of head injuries with head to head and elbow to head being the most common injury mechanisms. After the rule change head injuries were reduced by 29% (IRR 0.71, 95% CI, 0.57-0.86, p=0.002). Lacerations/abrasions declined most strongly with a reduction of 42%, followed by concussions/traumatic brain injuries (29%), contusions (18%) and facial fractures (16%). Elbow to head incidents were reduced by 23% (IRR 0.77, 95% CI, 0.46-1.29, p=0.32).
Discussion
Most head injuries in professional male football are caused by head to head and elbow to head contacts (Andersen et al., 2004; Fuller et al., 2005). After the rule change, the incidence rates for elbow to head incidents decreased as well as the incidence rates for all head injury types. This finding is in line with a former study that found a reduction in the rate of head incidents and head incidents caused by arm to head contact after stricter interpretation of the rules (Bjørneboe et al., 2013). Rule changes aiming to reduce injury occurrence in football seem to be appropriate means to achieve a reduction of head injuries and subsequently to maintain football players' health.
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Mini-Orals

MO-PM24 Molecular biology and biochemistry

SEX-SPECIFIC CHANGES IN MUSCLE FIBER AREA AND MYONUCLEAR CONTENT IN RESPONSE TO 10 WEEKS OF STRENGTH TRAINING

CUMMING, K.T.1, RAASTAD, T.1, PSILANDER, N.2
1: NORWEGIAN SCHOOL OF SPORT SCIENCES, OSLO, NORWAY. 2: SWEDISH SCHOOL OF SPORT AND HEALTH SCIENCES, STOCKHOLM, SWEDEN

Introduction
It is well known that females have lower muscle mass and strength than males (Janssen et al., 2000; Roberts et al., 2016). However, in response to strength training the relative changes in strength and muscle size is reported to be similar (Abe et al., 2000), or in some cases even superior in females (Hubal et al. 2005). As most studies focus on changes in whole muscle cross sectional area (CSA), only a few studies have investigated the response at a cellular level. The aim of this study was therefore to investigate sex differences in changes in strength, fiber CSA, and myonuclear content to 10-weeks of strength training.
Methods
Nine untrained males and ten untrained females performed three sessions per week for 10 weeks of unilateral leg press and leg extensions. During week 4 and 8 of the training period, the participants performed a block of five sessions of low-load blood flow restricted exercise. Knee extension 1RM and muscle biopsies (m. vastus lateralis) were sampled before and after the training period. Muscle sections were stained with antibodies against dystrophin, type 2 myosin heavy chain and nuclei (DAPI), and analyzed for fiber specific CSA and myonuclear content.
Results
After 10 weeks of training 1RM increased by 17±17 and 23±8% for males and females, respectively ($p<0.01$), with no differences between sexes. Males had larger type 2 fiber CSA, both at baseline and after the training period, compared to the females (Pre; 5131±1272 vs. 3070±538 um2. Post; 5618±934 vs. 4029±961 um2, $p<0.01$). Males also had more myonuclei in type 2 fibers at baseline (2.6±0.6 vs. 1.8±0.3, $p=0.02$). Only females increased type 2 fiber CSA ($p=0.01$) during the training period. Despite this increase, nuclear domain (no. myonuclei per um2 CSA) remained unchanged. Type 1 fiber CSA (Males; 4272±820 to 5150±1094 um2. Females; 3779±951 to 4100±1096 um2) and myonuclear content (Males; 1.9±0.4 to 2.1±0.4 nuclei per fiber. Females; 1.8±0.6 to 1.9±0.4 nuclei per fiber) remained unchanged with no sex differences.
Discussion
Only females increased CSA of their type 2 muscle fibers after 10 weeks of strength training. This may be related to the relative small type 2 fibers found at baseline. Furthermore, large individual variations in CSA of the type 2 fibers was observed for both sexes in response to the strength training. However, there was a positive trend towards larger relative increase in females. No significant training effect was found in type 1 fibers for neither men nor females.
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SATELLITE CELLS PROLIFERATIVE ACTIVITY IN ELITE KAYAKERS

MORAWIN, B.1, BAUMGARTEN, M.2, RYNKIEWICZ, M.2, POKRYWKA, A.1, ZEMBROŃ-ŁACNY, A.1
UNIVERSITY OF ZIELONA GÓRA

Introduction
Regeneration of damaged skeletal muscle is possible by the presence in muscle satellite cells (SCs) associated with muscle fibre. Insulin-like growth factor I (IGF-I) and testosterone (fT) are unique in being able to stimulate both the proliferation and the differentiation of SCs and work as part of an important repair and adaptive mechanism (Kvorning et al. 2007, Schoenfeld 2010). The study was designed to evaluate the blood levels of selected factors regulating the activity of SCs and the relationship between fT level and the axis of hGH/IGF-I.

Methods
Eight male kayakers, members of national team at the aged 19.1 ± 2.7 yr, were observed during the preparation period for the World Championship in Kayakers Marathon. Circulating regulators of the SCs activity (ELISA assays, R&D Systems) and body composition (Tanita MC-980) were estimated during the 4-wk conditioning camp.
Results
The anabolic factors, such as fT, IGF-I and hGH as well as IGF-I/IGFBP3 ratio, gradually increased on two consecutive weeks of conditioning camp and were strictly depended on the muscle damage (creatine kinase activity, CK). They reached the highest values at the 3rd week of the camp. The catabolic processes (cortisol level, C) increased at the 4th week and significantly affected the C/fT and C/IGF-I ratios. The serum IGF-I concentration was related to changes in C/fT ratio ($r = -0.517$, $p<0.001$) which may mean the inhibitory effect of high C and low fT concentrations on the release of IGF-I. It was also observed a significant correlation between fT and IGF-I ($r = 0.421$, $p<0.01$).
Discussion
The results of this study demonstrate that the sport training modulates the satellite cells proliferative activity, and show that the circulating markers of SCs proliferative activity can be useful diagnostic tool in biochemical assessment of skeletal muscle regeneration in athletes.
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Contact
B.Morawin@wlnz.uz.zgora.pl

ROLE OF SIRTUIN RELATED MICRO-RNAS IN OVERLOAD-INDUCED HYPERTROPHY OF SKELETAL MUSCLE IN RAT

KOLTAI, E., BORI, Z., CHABERT, C., DUBOUCHAUD, H., RADAK, Z.
UNIVERSITY OF PHYSICAL EDUCATION

Introduction
Significant skeletal muscle mass guarantees functional wellbeing and is important for high level performance in many sports. It is reported that inactivation of SIRT1 deacetylase activity results in reduced myofiber size, as well as in regeneration and depression of certain genes important to muscle development (Ryall et al., 2015). We suggested that SIRT1 can be a potential regulator of prosynthetic and catabolic signaling processes during compensatory hypertrophy of skeletal muscle, where the role of micro-RNAs could also be assumed.
Methods
Middle aged (15 months) male Wistar rats were used in the study and assigned to control and hypertrophy (n=7) groups. Overload of the plantaris muscle was performed bilaterally via removal of their major synergistic muscles, the gastrocnemius and soleus, as described previously. The surgical procedure was performed under deep anesthesia. The overload period lasted for 2 weeks. Plantaris muscle samples frozen in liquid nitrogen were analyzed by western blot, fluorescence method, TaqMan miRNA assay and Real-time PCR technic. The differences between groups were calculated by t-test ($p<0.05$).
Results
Fourteen days of overload resulted in more than a 40% increase in the mass of the plantaris muscles, which was associated with increased levels of mRNA, protein and activity of SIRT1. The levels of miR1 and miR133a decreased while the levels of miR23a, miR34a, miR125b and miR214 increased significantly in compensatory hypertrophy model. On the other hand the levels of miR128a and miR206 did not change significantly.
Discussion
According to our results, elevated SIRT1 activity detected in hypertrophy group goes together with increased muscle mass indicating the regulatory role of SIRT1 in modulating anabolic and catabolic pathways. The miR133a has binding sites for SIRT1 3'UTR-region, hence, the decreased miR133a levels suggesting enhanced production of SIRT1, which we indeed measured. Down-regulation of miR1 may also be important to muscle hypertrophy, because it has been shown that increased levels of miR1 during atrophy of skeletal muscle leading to decreased phosphorylation of anabolic factor, Akt (Kukreti et al., 2013). The level of miR1 down-regulates IGF-1 (Hu et al., 2013), indeed, miR1 even has a strong negative correlation with muscle mass, IGF-1 (IGF-1Ea and mechano-growth factor mRNA) and SIRT1. MiR-214 (Huang et al., 2008), miR206 and miR23-a (Drummond et al., 2009) have been suggested to play a role in the development of skeletal muscle. Overload induced changes in microRNA (miR) levels regulate SIRT1 and insulin-like growth factor 1 (IGF-1) signaling, which allow us to propose the hypothesis that SIRT1 and micro-RNAs may actually play a crucial causal role in overload induced hypertrophy of skeletal muscle.

EFFECT OF BRIGHT LIGHT EXPOSURE BEFORE SLEEP ON URINARY METABOLITES IN HUMANS

NAKAMURA, Y., CHOI, Y., AKAZAWA, N., PARK, I., KAWANA, F., SATOH, M., TOKUYAMA, K., MAEDA, S.
UNIVERSITY OF TSUKUBA

Introduction
Sleep plays an important role in regulation of physical and psychological health in athletes. Some studies have reported that exposure to bright artificial light before sleep affects sleep quality, daytime sleepiness, alertness, and circadian misalignment. However, the biological mechanism underlying bright right-induced decrease in sleep quality is unknown. Recently, it has been reported that specific metabolic pathways are associated with sleep deprivation. In this study, we investigated the effect of bright light exposure before sleep on urinary metabolites.
Methods
Eight young healthy men were performed both dim light (below 5 lux) condition (control condition: CON) and exposure to bright light (10000 lux) 3 hours before sleep (bright light condition: BL). The subjects were measured polysomnography (PSG) and body temperature before and during sleep. Both of two conditions, they went to bed at 0:00 and wake up at 7:00. After wake up, Oguri-Shirakawa-Azumi sleep inventory MA (OSA-MA) version were performed and urine samples were collected. Urinary metabolites were analyzed using capillary electrophoresis and time-of-flight mass spectrometry.

Results
In PSG analysis, sleep latency was significantly increased in BL. The score for refreshing of OSA-MA in BL was significantly lower than that in CON. Moreover, body temperature in BL significantly higher at around falling asleep compared with CON (23:30, 0:00, and 0:30). In urine metabolomics analysis, the level of allo-threonine was significantly higher and the levels of N-acerylleucine, ornithine, 5-hydroxylysine, carnosine, and 4-amino-3-hydroxybutyric acid were significantly lower compared with CON. In addition, the levels of adenosine tended to higher and the levels of glucosamine, 5-aminovaleric acid, subric acid, and anserine divalent tended to lower compared with CON.
Conclusion
We found that 3-h exposure to bright light before sleep inhibits sleep onset and disrupt circadian phase. Furthermore, some urinary metabolites changed in exposure to bright light before sleep. The present study suggests that exposure to bright light before sleep impacts urinary metabolites which are related to fatigue, energy metabolism, Gaba modulator, lipid metabolism, and cell bonded.

HYDROGEN WATER SUPPRESSES SKELETAL MUSCLE AND LIVER GLYCOGENOLYSIS DURING EXERCISE WHILE DOES NOT AFFECT OXIDATIVE STRESS, BLOOD ENERGY SUBSTRATE AND ENDURANCE PERFORMANCE IN RATS

KAWAMURA, T., FUJII, R., HIGASHIDA, K., MURAOKA, I.
WASEDA UNIVERSITY

Introduction
A number of recent studies reported that molecular hydrogen (H2) improves various diseases through antioxidant, anti-inflammatory, anti-apoptotic and energy metabolism stimulating effects (e.g. Ohsawa et al., 2007; Kamimura et al., 2011). In the sports science fields, however, the impacts of H2 on oxidative stress, energy metabolism and endurance performance have not been elucidated. Therefore, the purpose of this study was to examine the effects of two-weeks of H2 water intake on exercise-induced oxidative stress, energy metabolism and endurance performance in rats.
Methods
Male SD rats (n=32) were randomly divided into four groups: control (C), control-exercise (C-Ex), H2 water (H2) and H2 water-exercise (H2-Ex). Each group was provided with mineral water (C, C-Ex) or H2 water (H2, H2-Ex) for two-weeks ad libitum. Two-weeks after, C-Ex and H2-Ex groups were subjected to incremental exhaustive running as the endurance performance test. Blood, skeletal muscle and liver samples were analyzed for oxidative stress markers, blood energy substrates and glycogen contents.
Results
Delta total antioxidant capacity (TAC) in the skeletal muscle showed a higher tendency in the H2-Ex group than in the C-Ex group ($P=0.056$), whereas there was no significant difference in other oxidative stress markers in the blood and skeletal muscle. Δ Glycogen contents were significantly suppressed in the H2-Ex group compared to the C-Ex group in the skeletal muscle ($P<0.05$) and the liver ($P<0.001$) without changing the blood energy substrates (glucose, free fatty acid, triglyceride).
Discussion
The present study demonstrated that two-weeks of H2 water intake may enhance antioxidant capacity in the skeletal muscle and suppressed both skeletal muscle and liver glycogenolysis during exercise in rats. Since glycogenolysis in both tissues are regulated by various hormones (e.g. insulin, glucagon and adrenaline), we considered that H2 may have influenced these hormonal responses during exercise. Actually, it was reported that H2 induced hepatic fibroblast growth factor 21 (FGF21) gene expression, which functions to enhance fatty acid and glucose expenditure (Kamimura et al.2011). Therefore, it is necessary to further investigate the mechanism by which H2 suppresses glycogenolysis in both tissues during exercise, focusing on hormonal response and substrate utilization.
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Contact
takuji@toki.waseda.jp

EFFECT OF INTENSE TRAINING ON MUCOSAL IMMUNITY IN PREPUBERAL RHYTHMIC GYMNASTS

ANTUALPA, K.1,3, MOREIRA, A.1, AOKI, M.S.2
1,2: USP - SÃO PAULO'S UNIVERSITY, 3: DEVRY | METROCAMP

Introduction
There are conflicting reports on salivary immunoglobulin A (SIgA) and upper respiratory tract infection (illness) (URTI) responses from intense and reduced training loads (tapering) periods (Moraes et al., 2017; Papacosta et al., 2013). These responses are unknown in young prepuberal rhythmic gymnasts (RG) who are early exposed to high levels of physical and psychological stress (Georgopoulos et al, 2002). This study examined the effect of a 4-week intensified training phase (IT) followed by a 2-week tapering phase (TP) on SIgA and severity of URTI symptoms in youth RG. The rapid increases in training load (acute:chronic workload ratio) was examined.
Methods
Twenty-three RG (12.1±2.6 yrs; 143.9±13.7 cm; 37.2±9.4 kg) participated. Saliva samples were collected (beginning of IT, after IT and TP; analysed using ELISA). The WURSS-21 questionnaire was completed daily (to check severity of URTI symptoms). The session rating of perceived effort was used to quantify the internal training load (ITL). The acute:chronic workload ratio was determined (Hulin, Gabbett, Caputi, Lawson, Sampson, 2016). It is an index of the weekly training load divided by recent ITL (RITL). RITL was determined from previous 4-week rolling average ITL (habitual training; HT). An ANOVA with repeated measures for SIgA was used (with Bonferroni post-hoc test; $p\leq0.05$). The effect size (ES; 90% CL) was calculated to determine the meaningfulness of the difference between phases (HT, IT, and TP) for severity of URTI symptoms, and in the mean accumulated ITL. The ES magnitudes were classified as trivial (<0.2), small (≥0.2-0.6), moderate (>0.6-1.2) and large (>1.2).
Results
A higher SIgA concentration was observed after the IT (vs. pre-IT and post-TP; $p = 0.001$). Trivial and small effect sizes (0.15 to 0.37) were observed for changes in severity of URTI symptoms. The 90% CL suggested unclear changes for URTI. Greater ITL were undertaken during the 4-week IT. The acute workload ratios were 1.2 (0.3) for week 1 of the IT, 1.3 (0.3), for week 2, 1.3(0.3), for week 3, and 1.4 (0.3) for week 4.
Discussion

These results suggest that a 4-week IT might offer positive adaptation in mucosal immunity of prepuberal RG; to offer this positive effects, an acute:chronic workload ratio of 1.2-1.4 should be adopted. This acute:chronic workload ratio reference values might be used by coaches to organize an effective and safety intensification of training loads.

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EFFECT OF AEROBIC FITNESS ON PLASMA ASYMMETRIC DIMETHYLARGININE CONCENTRATIONS IN RESPONSE TO MAXIMAL EXERCISE TEST

PAWLAK-CHAOUCH, M., BOISSIÈRE, J., TAGOUGUI, S., GAMELIN, F.X., CUVELIER, G., BERTHOIN, S., HEYMAN, E., AUCOUTURIER, J.

UNIVERSITY OF LILLE 2

Introduction
Exercise capacity is involved to the maintenance of cardiovascular health, and an independent factor in cardiovascular risks (Williams, 2001). Asymmetric dimethylarginine (ADMA), a potential endogenous inhibitor of nitric oxide (NO) synthesis, has been proposed as a risk marker of cardiovascular diseases (Böger, 2006), and is associated with impaired exercise capacity in subjects with increased cardiovascular risks (Deftereos et al., 2014; Tanahashi et al., 2014). Our aim was therefore to determine whether plasma ADMA levels is independently related to exercise capacity in young subjects with no history of cardiovascular and metabolic diseases. We also intended to determine whether the profile from muscle deoxygenation in response to exercise is associated with plasma ADMA levels.
Methods
Twenty young, healthy, male subjects were recruited and divided into two groups based on aerobic fitness, as assessed by maximal oxygen uptake (VO2max) during a graded exercise test until volitional exhaustion. The criteria for inclusion were VO2max > 65 mL.kg-1.min-1 in the group with high aerobic fitness (HI-FIT) and VO2max < 65 mL.kg-1.min-1 in the group with low aerobic fitness (LO-FIT). Microvascular function was assessed through the profile of vastus lateralis muscle deoxygenation measured by near infrared spectroscopy (NIRS) in response to exercise test. Plasma ADMA and L-arginine analog levels were measured pre- and post-exercise test.
Results
No difference in plasma ADMA levels was observed between the LO-FIT and HI-FIT groups pre- (0.50±0.06 vs. 0.54±0.07, respectively) and post-exercise test (0.49±0.08 vs. 0.55±0.03, respectively). Post-exercise L-arginine/ADMA and Homoarginine/ADMA ratios were higher in the LO-FIT relative to the HI-FIT group (145.8±30.9 vs. 113.3±19.9, $p<0.05$; 3.2±0.6 vs. 2.2±1.1, $p<0.05$, respectively). The profile from muscle deoxygenation did not differ between the LO-FIT and HI-FIT groups, and was not associated with plasma ADMA and L-arginine analog levels.
Conclusion
Plasma L-arginine analog levels in normal ranges do not seem favorably affected by aerobic fitness in young, healthy, male subjects. No improved microvascular function was observed in subjects with high aerobic fitness relative to ones with low aerobic fitness.

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Mini-Orals

MO-BN02 Biomechanics: Running, cutting and jumping

KINEMATIC AND KINETIC DIFFERENCES BETWEEN SPRINTERS AND DISTANCE RUNNERS

PARADISIS, G., PAPPAS, P., DALLAS, G., TSIOUTSIOUMANOU, M., SOKRATOUS, T., ZACHAROGIANNIS, E.

NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS

Introduction
Several kinematic differences have been identified between sprinters and distance runners, such as in maximal speed, hip angle, knee angle, contact time, length and step frequency, and running economy (Bushnell & Hunter, 2007). Additionally, it has been indicated that high levels of leg and vertical stiffness are associated with increased running velocity and increases in leg stiffness are associated with increases in running economy. As no data exist regarding the differences between sprinters and distance runners for leg and vertical stiffness, the aim of this study was to identify these differences during treadmill running on constant speed of 6.67 m/s.
Methods
Eighteen healthy athletes (24.33 ± 3.01 years, 72.53 ± 5.59 kg and 180 ± 5 cm) ran on a treadmill at 6.67 m/s, and the flight and contact times were measured with a high-speed video camera (1200 frames/s). Leg and vertical stiffness calculation was performed using the sine-wave method which uses a small number of simple parameters (i.e. body mass, forward velocity, leg length, flight time, and contact time). The t-test for independent samples was used to identify possible differences between sprinters and distance runners.
Results and Discussion
The statistical analysis indicated that sprinters ran at 6.67 m/s speed with greater flight time ($p<0.05$, $t = 3.86$, 150 ± 19 ms vs. 122 ± 11 ms; 18.5%) and stride length ($p< 0.05$, $t = 3.50$, 2.09 ± 0.13 m vs. 1.93 ± 0.06 m; 7.8%) compared to distance runners. On the other hand, distance runners adopted an 8.2% greater stride frequency ($p<0.05$, $t = 3.51$, 3.46 ± 0.11 Hz vs. 3.20 ± 0.20 Hz). The maximal ground reaction force during contact ($p<0.05$, $t = 2.65$, 2.15 ± 0.16 kN vs. 1.94 ± 0.18 kN; 9.82%) and the vertical displacement of the centre of mass (COM) ($p<0.05$, $t = 3.17$, 47 ± 5 mm vs. 41 ± 2 mm; 12.99%) were greater for the sprinters. There were not statistically significant differences in leg (9.90 ± 1.22 kN/m/kg, vs. 8.94 ±1.39 kN/m/kg) and vertical (45.74 kN/m/kg vs. 47.25 ± 4.70 kN/m/kg) stiffness between sprinters and distance runners even though the values of leg stiffness for sprinters were 9.8% greater. Sprinters produced more power

during contact and as a consequence, they adopted a larger oscillation of the COM and longer stride length compared to distance runners, during treadmill running at 6.67 m/s. Even though there are some trends showing greater leg stiffness for sprinters, statistical analysis did not confirm that indicating the necessity for further research with larger number of participants.

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INDICATION OF FATIGUE FORM GROUND REACTION FORCE CURVE FOR LONG DISTANCE RUNNERS

ATTAALLAH, M., ABDELGAWAD, A., ABOZAID, K.

FACULTY OF PHYSICAL EDUCATION, ALEXANDRIA UNIVERSITY, EGYPT.

Introduction

Running is one of the most important events in sport and requires more ability strength and speed. vertical jump for 60 s on the force platform examines the mechanical power for lower extremity (Carmelo Bosco, Luhtanen, & Komi, 1983). Nevertheless, this is cost muscle fatigue. So, if we detect the fatigue early it could be employed as an indicator to reduce the chances of injury. Therefore, the purpose of this study was to identify the changes in the force-time curve characteristics during repeated vertical jump for 60 s.

Methods

seven male runners (age: 19.2 ± 0.8 y; height: 179.4 ± 2.9 cm; mass: 68.9.2 ± 10.9 kg) Bertec force plate (1000Hz) for data collection and SIGVIEW v 2.6 software for processing. The subjects performed warm-up and each one performed one trial of the continuous vertical jump for 60 s. Data was divided into three parts each part equal 20 s (First, Middle and Final).

Results

Mean and standard deviation of the variables in Three parts Peak Force (BW) (2.15 ± 0.27, 2.0 ± 0.22, 1.86 ± 0.24) and Time to peak Force(s) (0.57 ± 0.16, 0.50 ± 0.15, 0.71 ± 0.11) Jump Height (m) (0.26 ± 0.06, 0.21 ± 0.06, 0.18 ± 0.04) Peak count (number) (14.86 ± 1.07, 16.14 ± 1.57, 13.86 ± 2.61) respectively.

Discussion

In the first part, the subjects produced maximum peak force within less time this exceeds the jump height and number of jumps (14.86) because increasing of flight time. While, in the Middle part the result showed decreased of peak force (6.9%) and time to peak force (13.1%) from the first part and jump height was decreased (17.6%) with increasing the number of jumps (16) this agrees with (Ronglan, Raastad, & Børgesen, 2006). The repeated jump for a long time reduce the lower extremity flexion and jumped height of the subjects and the ability of lower extremity muscles to push-up (C. Bosco et al., 1996). In addition, the subjects try to recover some of his ability of jump to overcome the fatigue and complete the test. In the third part, all variables were decreased peak of force (13.6%) jump height (30.8%), the number of jumps (13.86), except the time to peak force was increasing (23.2%). Finally, this study suggests that 40s of repeated vertical jump test are enough to estimate the fatigue.

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Contact

dr.mansour.ata-allah@alexu.edu.eg

REPEATED SPRINTING ON THIRD-GENERATION ARTIFICIAL TURF DOES NOT ALTER PLANTAR LOADING IN INTERNATIONAL MALE FOOTBALL PLAYERS USING A FATIGUE INDUCING PROTOCOL

GIRARD, O., MILLET, G.P., THOMSON, A., BROCHERIE, F.

ASPETAR ORTHOPAEDIC AND SPORTS MEDICINE HOSPITAL

Introduction

We compared changes in plantar loading using a fatigue inducing protocol over two distinct intervals of the sprint distance in elite football.

Methods

Twelve International male football outfield players (Qatar Football Association) completed 6 × 35-m sprints interspersed with 10 s of active recovery on third-generation artificial turf with their football boots. Insole plantar pressure distribution was continuously recorded and values (whole foot and under 9 foot areas subsequently averaged and compared over two distinct distance intervals (0–17.5 m or acceleration phase vs. 17.5–35 m or terminal phase).

Results

Sprint times increased ($P < 0.001$) from the first to the last repetition (percentage sprint decrement score of 8.6 ± 2.8%), independently of the distance interval. For the whole foot, contact time (150 ± 23 vs. 158 ± 19 ms; -5.8 ± 9.1%), maximal force (1910 ± 559 vs. 2211 ± 613 N; -16.9 ± 18.2%) and mean pressure (154 ± 41 vs. 172 ± 37 kPa; -13.9 ± 19.0%) were lower in the acceleration vs. terminal phase (all $P < 0.05$). There were no main effects of sprint number or any significant distance interval × sprint number interactions for any plantar variables of the whole foot (all $P > 0.05$). There were no main effects of sprint number or any significant interactions (sprint number × distance interval) for any plantar variables of the whole foot (all $P > 0.05$). The interaction on relative loads was not significant ($P > 0.05$).

Discussion

In summary, fatigue inducing protocol completion by male professional football players on artificial turf led to substantial lengthening in sprint times across repetitions. Differences in plantar loading (whole foot) occurred between the acceleration and terminal phases of each 35-m sprint, but were independent from sprints repetition. Fatigue led to a decrement in sprint time but no significant change in plantar pressure distribution patterns across sprints repetition.

ROLE OF TRUNK MUSCLE CO-CONTRACTION DURING DJ FROM DIFFERENT HEIGHTS AND INSTABILITY CONDITIONS

PAULS, M., ZANGERL, C., FRÖHLICH, M., GÜLLICH, A.

TU KAISERSLAUTERN

Introduction

Neuromuscular control of trunk is associated with parameters of dynamic knee stability during jumps (Prieske et al., 2013). For instance, insufficient trunk stability, unstable surfaces, different heights and gender predicts higher knee impact loads. This study investigates gender differences relating to the association between trunk muscle co-contraction and 3D lower body biomechanics during drop jumps (DJ) from different heights with and without instability condition.

Methods

3D full body kinematics (Qualisys) and electromyographic (EMG) activity (Noraxon) of trunk muscles (m. erector spinae (ES) and m. rectus abdominis (RA)) were recorded in physically active subjects (n=43 age 19.4±3.9y, 27m, 16f) performing DJ with their right leg on a force plate (Bertec) from different dropping heights (H1=0, H2=15, H3=30 cm) under stable and unstable (AIREX balance pad) condition (SC, ISC). Peak knee valgus moment within 30% of contact time (KVMmax) was elected for analysis of knee, because of its relevance to knee impact load. Furthermore, ratio between normalized ES and RA activity (RESRA) as trunk muscle co-contraction value were calculated when KVMmax occurs. Pearson´s correlation between RESRA and knee stability parameter (knee flexion angle (KFA), knee valgus angle (KVA), knee flexion moment (KFM), knee valgus moment (KVM)) were analyzed for m and f subjects, respectively. For all statistical analysis α=0.05 was accepted as level of statistical significance.

Results

Under SC there is no significant correlation for any parameter of knee stability, whether for gender nor for different dropping heights. For ISC significant correlations were found between RESRA and KFA in both, men ($-.62 \leq r \leq -.79$; $p<.05$) and women ($-.68 \leq r \leq .78$; $p< .05$). KVA shows a significant correlation only for females in H1 ($r=.78$; $p<.01$). When regarding KFM there is high correlation in men in H2 ($r=-.82$; $p=.001$) and a moderate correlation in women in H3 ($r=.52$; $p<.01$). No correlations could be found for KVM.

Discussion

First, KFA is decreased with higher RESRA which means that activity of ES was higher than RA and less co-contraction occurs. Referring to this, it could be assumed that trunk stability is lacking and hence decreased KFA seems to be of higher knee injury risk. Secondly, there are only limited findings on KVA and KVM, which imply that knee stability parameter are less affected by trunk stability during DJs. Finally, compared to gender differences RESRA and KFM display a negative association in men for H2 and positive in women for H3. This reveals that there could be a different biomechanical or neuromuscular strategy between gender. The present findings suggest that trunk muscle co-contraction as a predictor of trunk stability is of higher interest in ISC with increased dropping heights.

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Contact

m.pauls@sowi.uni-kl.de

POTENTIATING EFFECTS OF FREE WEIGHT AND ELASTIC BAND BACK SQUAT EXERCISES ON SUBSEQUENT VERTICAL JUMP PERFORMANCE

MINA, M.A.1, BLAZEVICH, A.J.2, GIAKAS, G.3, TSATALAS, T.3, SEITZ, L.2, HOOTON, A.1, LEVANTINOU, R.3, KAY, A.D.4

1: UOD (DERBY, UK), 2: ECU (PERTH, WA), 3: UOT (THESSALY, GREECE), 4: UON (NORTHAMPTON, UK)

Introduction

Performing maximal or near-maximal contractions during a warm-up can induce short-term increases in force production, a phenomenon termed as post-activation potentiation (PAP). Varying the load during a back squat using elastic bands (EB) in combination with free-weight resistance (FWR) can manipulate the loading characteristics of the lift. This may enhance total muscle force production (impulse), and thus muscle work, and hypothetically augment the PAP response. Therefore, the aim of this study was to examine the influence of EB during warm-up squat exercises on subsequent vertical jump (VJ) performance.

Methods

Fifteen active men (age = 21.5 ± 3.9 y, height = 1.8 ± 0.7 m, mass = 77.2 ± 9.5 kg) volunteered for the study. On two separate occasions, participants performed a comprehensive warm-up of 5 min cycling, and 10 continuous unloaded squats, 5 continuous vertical jumps at ~70% of maximum, followed 30 s later by maximal jumps performed every 30 s until 3 jumps were performed within 3% of jump height. After 30 s, participants then performed 3 repetitions of either EB or FWR back squats at 85% 1-RM (35% of load generated from elastic resistance during EB). VJ were then performed 30 s, 4 min, 8 min, and 12 min later. Motion analysis and two force platforms recorded kinetic and kinematic data, with vastus lateralis (VL), vastus medialis (VM), gluteus maximus (Glut), and gastrocnemius (GM) electromyograms (EMG) simultaneously recorded during the VJ. Repeated measures ANOVA's were used to examine differences between conditions; significance was accepted at $p<0.05$.

Results

A significant increase in VJ height (6.4-9.3%), net impulse (3.2-4.1%), peak power (4.4-6.2%) and peak knee angular velocity (3.0-4.1%) in the concentric phase was found at 30 s, 4 min and 8 min following the EB condition, with no change in maximum knee flexion angle. A significant increase in mean concentric VL EMG was also found at the same time points (21.3-24.6%) following EB. Nonetheless, no significant change in VJ height was observed after the FWR warm up.

Discussion

VJ performance was significantly increased following the warm-up with additional elastic band resistance during the squat exercise, but not in the free-weight squat condition. The increase in EMG amplitude in the concentric phase indicates that greater muscle activation may have played a role in the response, resulting in an increase in movement velocity, net impulse and power. As no change was found in FWR, elastic band use could provide for a more effective warm-up prior to athletic performance.

Contact

m.mina@derby.ac.uk

DIFFERENCES AND SIMILARITIES OF KINEMATIC TRIPLE JUMP PARAMETERS BETWEEN YOUTH AND ELITE ATHLETES

JASPERT, A.1,2, JAITNER, T.1, HAHN, D.2,3

1: TU DORTMUND UNIVERSITY (GERMANY), 2: RUHR-UNIVERSITY BOCHUM (GERMANY), 3: UNIVERSITY OF QUEENSLAND (AUSTRALIA)

Introduction
Not until the age of 15, the competitive triple jump is open to youth athletes in Germany. Due to less training experience, youth athletes, certainly, achieve shorter triple jump distances compared to elite athletes. For female novice athletes different phase ratios of the hop, step and jump have been reported (Larkins, 1988), whereas contact times did not differ between different levels of expertise (Fukashiro & Miyashita, 1983). The aim of this study was to analyze kinematic triple jump parameters between female as well as male youth and elite athletes to figure out if the youth still lack technical skills compared to their elite counterparts and if their characteristics differ according to gender.
Methods
Absolute and phase distances as well as contact times of hop, step and jump were recorded using Optojump next™ (Microgate, Italy) during national under-16 championships. Actual overall distance, phase distances and phase ratios (% of overall distance) were determined according to Hay (1993). Best performances of the eight male (m) and female (f) finalist were compared to the data of elite athletes from the 2011 World Championships (Bae et al., 2011). Statistics included Mann-Whitney U tests.
Results
Elite athletes showed significantly greater actual overall (m: 17.64±0.22m vs. 12.60±0.29m; f: 14.71±0.34m vs, 11.47±0.52m) and phase distances ($p=.000$, $r>.8$). There were no significant differences between the phase ratios of female youth and elite athletes, while male youth athletes showed a significantly smaller step ratio (25±3% vs. 30±1%; $p=.002$, $r=.73$) and a greater jump ratio (37±4% vs. 34±2%; $p=.050$, $r=.49$) compared to elite athletes. No significant differences in contact times were found for either phases or groups.
Discussion
As expected, elite athletes achieve longer overall and phase distances but do not show different contact times. However, we could not verify differences for all phase ratios. Female youth triple jumpers seem to pursue similar jump strategies to elite athletes while male youth performances are mainly characterized by a shorter step ratio. In line with Tønnessen et al. (2015) we speculate that male athletes improve considerably more than female adolescence whereas female youth already draw closer to their top performance at that age. However, strength and power capacities of youth athletes need to be considered in future studies to prove our presumption.
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Contact
alessa.jaspert@rub.de

BIOMECHANICAL CHARACTERISTICS OF VOLLEY KICKING FOR A CROSS BALL WITH VARIOUS HIGHTS IN SOCCER

SHINKAI, H.1, INOUE, K.2, NUNOME, H.3

1: TOKYO GAKUGEI UNIVERSITY (TOKYO, JAPAN), 2: YAMAGATA UNIVERSITY (YAMAGATA, JAPAN), 3: FUKUOKA UNIVERSITY (FUKUOKA, JAPAN)

Introduction
In soccer, volley kicking is one of the most difficult kicks to make compatible ball velocity and accuracy. There was only study which try to reproduce the volley kicking by placing the ball on paper pipes (Sugi et al., 2016); however, this kicking is greatly differ in difficulty from volley kicking for cross ball during a game. The aim of this study was to reveal the change of volley kicking motion and performance for a flying ball with various heights.
Methods
Two varsity footballers with similar physique participated. They were instructed to shoot the flying ball in various heights from the side launched by the ball serving machine with full effort aiming at the centre of the soccer goal 9 m ahead. Total 69 motions were captured by a motion capture system (240 Hz) and 3 high-speed cameras (200 Hz). These kicks were classified into 3 categories about the ball heights at the impact: high, middle, and low. Ball velocity and accuracy, motion time, and kinematics of kicking and support leg were compared among three conditions.
Results
Almost all the kicked balls were located in the width of the goal, while more than half of trials were out of the goal in the vertical direction (above the goal or one bounce). Ball velocity of the anterior component in high condition was significantly lower than the middle condition. There was no difference in the motion time from toe off of the kicking leg to ball impact among three conditions. In high condition, however, the timing of support foot contact was earlier, and the swing time of the kicking leg became longer than the others. Foot velocity of the anterior component just before ball impact in high condition was smaller than the other conditions, and that of upward component became larger as the ball height increase. In addition, in high condition, knee extension angular displacement of the support leg during its contact was remarkably larger than the others.
Discussion
In the volley kicking, it was found that the ball varies more vertically rather than horizontally. The players abduct the hip of the kicking leg (Sugi et al. 2016) and extend the knee of the support leg to raise their kicking foot in the high condition. Moreover, the players make a horizontally posture of the kicking foot to hit the ball with their instep. Since the hitting point of the ball (its centre) is easy to shift vertically direction due to above motions, it can be suggested that paying attention to these motions is important for success of high volley kicking.
Acknowledgement
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Contact
shinkai@u-gakugei.ac.jp

MINIMAL MOMENTS OF INERTIA – AN ANALYSIS OF OPTIMAL TWIST AND SOMERSAULT POSITIONS

SCHÜLER, A., DEE, R., UEBERSCHÄR, O., FICHTNER, I.

INSTITUTE FOR APPLIED TRAINING SCIENCE

Introduction
In gymnastics, diving and figure skating the athlete strives for tight rotation positions. Small moments of inertia are essential for both twists and somersaults to maximize rotational speed. The aim of this study was to compare five straight positions and four tucked positions with respect to their moments of inertia around the longitudinal and the transverse axes, respectively.
Methods
Two male gymnasts (60.5 kg and 70.0 kg; 1.61 m and 1.77 m) were captured by laser scanner (VITUS Smart XXL, Human Solutions GmbH) in erect standing position as well as in four further straight and four other tucked positions. We distinguished tuck positions with face-up or face-down and with wide open or closed knees. Knoll et al. (2016) used a surface method to compute moments of inertia: A 3D polygonal surface mesh is determined from the point cloud of the rough scan. Using MeshLab (Visual Computing Lab, ISTI-CNR, Pisa) the volume-based inertia tensor was computed. Assuming a homogeneous body density, it was then transferred to a mass-based inertia tensor by multiplicative scaling. In tucked positions, surface mesh fusion of different body segments may occur, resulting in an artificial volume increase of up to 10 % larger compared to the true volume in standing position. Rescaling of the mesh volume to that of standing position is applied for correction.
Results
Three straight positions (arms at the side, arms in pull-up and arms in boxer position) yield similar moments of inertia with respect to the longitudinal axis. However, the diver positions (left hand behind the head, right hand at left hip) and the so-called "pharaoh position" (arms crossed in front of the chest) have 8 – 12 % lower moments of inertia compared to the erect standing positions. Somersaults with face-up tucked positions, in contrast, prove inadvisable. Their moments of inertia are up to 40 % higher than in face-down tucked position. Moreover, no differences were observed between open knee and closed knee positions.
Discussion
The 3D laser scanner surface mesh of an athlete has been proved a useful tool to identify optimal twist and somersault positions. Validity has been shown against standard inertia models (Knoll et al, 2016). The present studies will be expanded to piked positions in future. Our results will help to optimize positions and complex motion in gymnastics, diving and figure skating.
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Contact
schueler@iat.uni-leipzig.de

Mini-Orals

MO-PM27 Muscle function

OPTIMUM PORTION OF FORCE-DISPLACEMENT CURVE TO ASSESS MUSCLE HARDNESS WITH A PUSH-IN METER

MURAYAMA, M.1, NOSAKA, K.2, INAMI, T.3, SHIMA, N.4, YONEDA, T.5

1: KEIO UNIV. (JAPAN), 2: EDITH COWAN UNIV. (AUSTRALIA), 3: WASEDA UNIV. (JAPAN), 4: TOKAI-GAKUEN UNIV. (JAPAN), 5: JUNTENDO UNIV. (JAPAN)

Introduction
Muscle hardness can be assessed by the responded force from the muscle to the pressure of a probe that is pushed into the muscle. To calculate muscle hardness using a push-in meter, it is necessary to find a linear portion in the force-displacement curve (FDC) (1). The linearity of FDC appears to be dependent on muscle thickness (MT). Thus, it is important to find optimum portion of FDC in relation to MT for accurate assessments of muscle hardness, but no previous study has examined this. The present study compared the coefficient of determination (R ^ 2) values of the regression equations obtained from several different portions of the FDC to find the best portion.
Methods
Forty-seven men (28.0 ± 9.8 y, 176.3 ± 7.2 cm, 72.5 ± 10.9 kg) participated in the present study. Hardness of the biceps brachii muscle was measured at the mid-belly by a pressure meter (TK-HS100: Tokushu-keisoku, Japan). The thickness of the muscle and subcutaneous tissue (ST) were measured by B-mode ultrasonography, and the push-in meter probe was inserted 25-mm from the skin surface. FDC of the muscle component was identified, and linear regression coefficients of 10 different portions relative to MT were calculated: 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50% MT. One-way ANOVA was used to compare the 10 R ^ 2 values obtained from the different MT, followed by a post-hoc Dunnett's T3 test.
Results
Mean (±SD) values of ST and MT were 2.7 ± 0.9 mm, 23.9 ± 4.7 mm, respectively. Mean values of R ^ 2 in 10 slopes were increased from 5% MT (0.821) to 25% MT (0.987) and 30% MT (0.987), then decreased from 35% of MT (0.985) to 50% MT (0.972). One-way ANOVA showed a significant ($p < 0.01$) effect for R ^ 2 values among the slopes, and the post-hoc test showed that R ^ 2 was smaller for 5%, 10%, 45% and 50% MT than others, and no significant differences were evident among 15, 20, 25, 30, 35, to 40% MT. The linearity of FDC was high between 15% MT to 40% MT, but the highest at 25% and 30% MT.
Discussion
The results showed that mean R ^ 2 values in different slopes were the largest at 25% and 30% MT, although no significant difference existed among 15% to 40% MT. Steinberg et al. (2) demonstrated that the force-displacement curve in muscle hardness assessment could be divided into three parts: subcutaneous tissue part, quantitative muscle hardness part and muscle compaction part. It seems that non-linear response in FDC was caused by enhancement of muscle compaction from a deep indentation and the decrease in R ^ 2 values over 35% MT was probably due to muscle compaction. Thus, it is better to calculate muscle hardness based on the slope up to 30% MT in FDC, and to have more data points. Thus, it is concluded that muscle hardness using a push-in meter should be calculated using the FDC at 30% MT depth for biceps brachii muscle.

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Contact
Murayama@z3.keio.jp

LOWER EXTREMITY MUSCLE CO-CONTRACTION CHARATERS DURING DIFFERENT PLANE OF LUNGES IN HEALTHY INDIVIDUALS

DAI, Y.X., LIN, J.Z., LEE, H.J.

NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction
Lunge exercises were widely been used to strengthen the quadriceps and hamstrings muscles, and co-activation of the quadriceps and hamstrings could affect stabilization of the knee and movement (Begalle et al., 2012). Therefore, identifying lunges that facilitate balanced activation of the quadriceps and hamstrings might be beneficial in knee joint injury prevention and stabilization of movement. The purpose of this study was to examine the co-activation of the quadriceps and hamstrings during multiple planes of lunges.
Methods
There were ten healthy collegiate individuals volunteered to participate in this study (age 20.8 ±1.0 yrs, height 172.8 ±.4.3 cm, weight 65.0 ± 6.9 kg). Surface EMG signals were collected by five Delsys Trigno sensors at 1000 Hz. Sensors were placed on rectus femoris, vastus lateralis, vastus medialis, biceps femoris, semitendinosus of the dominant leg. All participants were instructed to perform three lunges correctly: forward lunge, side lunge and reverse lunge. Visual 3D software was used for EMG signal post processing. The peak EMG was acquired from the quadriceps and hamstring of each subject to normalize muscle activation data recorded during the exercises. Raw EMG data were band-pass filtered at 20 to 450 Hz, full-wave rectification and smoothed using a root mean square with a constant 20 ms window. One-way ANOVA with repeated measures was used to exam the differences in biomechanical parameters of the lower limb muscle activations during multiple planes of lunges.
Results
The muscle co-activation ratios (Q:H) are calculated as mean quadriceps activation divided by mean hamstring activations during movement. The Q:H ratios of reverse lunge during descending phase was significantly smaller than other two lunge exercises. The Q:H ratios during ascending phase were not found significant among three lunge exercises.
Discussion
A resulting Q:H ratio equal or close to 1.0 indicates a more balanced muscle activation. The smaller Q:H ratio (close to 1.0) during descending phase of reverse lunge could be peculated that reverse lunge was a more hamstring dominant exercise than other two lunge exercises. A significant greater Q:H ratio of forward and side lunges could indicate that a stronger quadriceps muscle activation was existed and tended to lead to greater stresses on the knee joints during descending phase (Escamilla et al., 2008). From the results of the current study, reverse lunge during descending phase could help to facilitate more antagonist muscle activations which could be ideally applied to who had concerns regarding anterior knee stresses. Therefore, reverse lunge could be a better rehabilitation exercise for ACL injury individuals to adopt.
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Contact
Soleuslee86@yahoo.com

THE STUDY OF UPPER QUARTER FUNCTIONAL STABILITY IN DEAF ELITE MALE SWIMMERS

LATIFI, S., DANESHMANDI, H., ALIZADEH, M.H., SHIRZAD, E.

UNIVERSITY OF TEHRAN, UNIERSITY OF GUILAN, UNIVERSITY OF TEHRAN. UNIVERSITY OF TEHRAN.

Introduction
Often The problems of deaf people are considered only the aspects of communication. However, the communication problems are the main defect caused by hearing loss, it is likely other health issues associated with hearing loss. In this field, deficiency of balance due to damage of sensory integration and motor development is the one of defects is often seen in deaf people (Cushing et al. 2008). An optimal level of balance and stability are necessary for successful performance in many overhead sports, and swimming is no exception (Butler et al. 2014).
Methods
Ten Deaf elite male swimmers (age=17.64±1.39) and 10 elite male swimmers without any hearing impairment (age=17.78±1.57) have participated in this study. Upper quarter Y balance test (YBT-UQ) was used for measuring functional stability of both dominant and non-dominant shoulder. After checking the normal distribution of the results with 1-s Kolmogorov-Smirnov, paired sample t-test and independent sample t-test were used for comparing the dominant and non-dominant shoulder's functional stability and for comparing the results between groups, respectively.
Results
No significant difference was observed between functional stability of both shoulders of the healthy group (P=0.144) and deaf group (P=0.212). There was significant difference between two groups; so that the stability and balance of upper quarter of the healthy group was better than the deaf group in both dominant and non-dominant sides($P<0.05$).
Discussion
Since the vestibular system and the cochlea are so closely anatomically therefore, in case of damage to a section, the other part may be impaired. In this case, this hypothesis can be considered logical that deaf people with sensorineural hearing loss, have vestibular problems (Gorman et al. 2012) The body and head position relative to gravity in the YBT-UQ test changes that this situation makes more dependence on vestibular – cochlear system. And it seems the deficit in the balance due to this system could be worse. On the other hand the deficit in the balance can impair motor development of deaf people (Winter et al. 1990).
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GENDER EFFECT ON BILATERAL IMPACT FORCE AND IMPACT TIME DURING PLYOMETRIC JUMPING WITH RELATIVE HEIGHT

GU, C.

NATIONAL DONG HWA UNIVERSITY

Introduction
Female athletes are at greater risk for lower extremity injury from drop landings than male athletes are (Arendt & Dick, 1995). Previous studies indicate a gender difference in lower extremity bilateral symmetry resulting in greater lower extremity injury in females (Pappas & Carpes, 2012). Physiologically, females have lower muscular strength and consequently a lower jump height. Many studies on drop jump (DJ) have used the same drop height for both genders; only a few studies have considered the gender difference in jump height, and their results vary (Weinhandl et al., 2010; Weinhandl et al., 2015). Hence, a research considering individual differences is warranted.
Methods
Eight male and eight female college students from the physical education department were selected for the study and asked to perform 3 DJs at relative drop heights (RHs). The maximum height of the countermovement jump (CMJ) was set as the RH (Males: 0.46 ± 0.04 m, Females: 0.31 ± 0.03 m). Two AMTI force plates and a QTM motion capture system were used to record ground reaction forces (GRF). The data were analysed using an independent-sample t-test for gender (α=.05).
Results
There was no significant gender difference in peak impact forces (I-vGRF) on the dominant leg (Males: 2.13 ± 0.41 BW, Females: 1.72 ± 0.48 BW, p>.05). Males had a greater I-vGRF on the nondominant leg (Males: 2.08 ± 0.48 BW, Females: 1.57 ± 0.30 BW, p<.05). There was no significant gender difference in bilateral asymmetry of I-vGRF (Males: 0.24 ± 0.06 BW, Females: 0.41 ± 0.25 BW, p>.05). The bilateral asymmetry at the time of I-vGRF was significantly greater for females (Males: 4.27 ± 3.32 ms, Females: 10.52 ± 5.72 ms, p<.05).
Discussion
Previous studies based on the same drop height for both genders indicate that females bear greater I-vGRF than males. Our findings show that the I-vGRF for males on the nondominant leg is greater than that for females with a DJ based on the RH, possibly resulting from males' inherently higher drop jump. Notably, the I-vGRF for females jumping from a lower height on the dominant leg is close to that for males; this result is probably related to the fact that females have more one-leg dominance when landing (Hewett et al., 2006). Therefore, females may experience higher impact loading because of their greater dependence on the dominant leg (Weinhandl, Irmischer, Sievert & Fontenot, 2016). Bilateral asymmetry in lower extremities has widely been considered an important predictor for potential risk of injury (Hewett et al., 1999; Weinhandl et al., 2016). Females have greater bilateral asymmetry in terms of impact time and greater bilateral asymmetry when performing a DJ with a respective RH; hence, they have a higher risk of injury.
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Contact
tennis01@gms.ndhu.edu.tw

CHANGES IN BICEPS BRACHII MUSCLE HARDNESS ASSESSSED BY ULTRASOUND STRAIN ELASTOGRAPHY AFTER ECCENTRIC EXERCISE OF THE ELBOW FLEXORS

INAMI, T.1, MURAYAMA, M.2, SHIMA, N.3, NOSAKA, K.1

1:EDITH COWAN UNIVERSITY, 2:KEIO UNIVERSITY, 3:TOKAI GAKUEN UNIVERSITY

Introduction
Gastrocnemius muscle hardness assessed by strain ratio [SR] of ultrasound strain elastography decreased linearly from rest (1.28 ± 0.2) to 25% (0.99 ± 0.21), 50% (0.61 ± 0.15) and 75% (0.34 ± 0.1) of maximal voluntary contraction (MVC) of the plantar flexors [1]. Muscle hardness increases after eccentric exercise resulting in muscle damage [2]; however, no previous study has investigated SR changes after eccentric exercise for relaxing and contracting muscles. The present study examined changes in SR of biceps brachii after eccentric exercise of the elbow flexors for relaxing and contracting conditions to see whether contracting conditions provide any different information.
Methods
Ten men (20-34 y) performed 5 sets of 10 eccentric contractions of the elbow flexors using a dumbbell set at 80% of MVC. Ultrasound elastography images were taken before, immediately after, and 1 to 4 days after the exercise using strain elastograpy (Prosound F75, Hitachi Aloka Medical, Japan). The investigator gently pressed a probe with a reference material (acoustic coupler, 22.6 Kpa) over biceps brachii mid-belly when the muscle was relaxing and producing 15%, 30% of the baseline MVC, and 30% of MVC of the day at 90° elbow flexion. A circular (φ=5 mm) region of interest (ROI) was placed in the coupler and a large ROI (φ=30-50 mm) was set to include whole biceps brachii to calculate SR (muscle/acoustic coupler). Changes in SR at relaxing and contracting muscles over time were compared by two-way repeated measures ANOVA.
Results
SR of relaxing muscle decreased from the baseline (1.05 ± 0.36), immediately after (0.83 ± 0.27), 1 (0.77 ± 0.28), 2 (0.73 ± 0.22), 3 (0.67 ± 0.17) and 4 days (0.67 ± 0.19) after eccentric exercise (p<0.05). SR of contracting muscle also decreased (p<0.05) from the baseline values (15%: 0.26 ± 0.09, 30%: 0.13 ± 0.04, 30% of the day: 0.13 ± 0.04), immediately after (0.16 ± 0.05, 0.07 ± 0.03, 0.10 ± 0.03), 1 (0.18 ± 0.06,

0.11 ± 0.04, 0.13 ± 0.04), 2 (0.18 ± 0.06, 0.11 ± 0.04, 0.13 ± 0.05), 3 (0.17 ± 0.06, 0.10 ± 0.04, 0.12 ± 0.05) and 4 days post-exercise (0.18 ± 0.05, 0.10 ± 0.04, 0.12 ± 0.04). A significant intensity x time interaction effect was evident such that SR continued to decrease from immediately (21%) to 4 days post-exercise (34%) for relaxing muscle, but the decrease of SR was the largest immediately post-exercise (50%) for contracting muscle.
Discussion
The changes in SR of relaxing muscle were consistent with a previous study [2]. SR of contracting muscles were 73-92% smaller than that of relaxing muscle, and the difference was the largest at immediately post-exercise (81-92%). This suggests that the time course of changes in SR is different between relaxing and contracting muscle, thus the contracting condition may add more information for muscle hardness changes after eccentric exercise.
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Contact
inami0919@gmail.com

EFFECTS OF ACUTE LOCAL HEATING/COOLING ON RELATIONSHIPS BETWEEN MUSCLE HARDNESS, MUSCLE TIGHTNESS AND RANGE OF MOTION AT BICEPS FEMORIS MUSCLES

HIGASHINO, Y., AYABE, M., OKITA, Y., ISHIZAKI, S.
OKAYAMA PREFECTURAL UNIVERSITY, SHIBAURA INSTITUTE OF TECHNOLOGY

Introduction
The purpose of the present investigation was to examine the effects of the acute local heating/cooling on the relationships between the muscle hardness, the muscle tightness and the range of motion at biceps femoris muscles in young collegiate soccer players.
Methods
The subjects of the present investigation were ten male university students who regularly exercised and were not currently being treated for lower limb injury (21 ± 1 years of age, 174.5 ± 3.5 cm of height, 66.1 ± 3.5 kg of body mass, 21.7 ± 0.9 kg/m2 of body mass index). All subjects measured flexibility (muscle hardness, range of motions, muscle tightness test) before and after the 20 minutes of the acute local heating/cooling at hamstrings of the right foot. Two experiments were separated at least 3 days, and were randomly ordered. The muscle hardness was measured by the muscle hardness meter. The range motion of hip joint extension, hip joint inner rotation, hip joint external rotation, knee joint flexion, as well as the muscle tightness of hamstrings, measured using a standardized goniometer.
Results
As results of the 2-way repeated ANOVA (treatment * timing), there are significant interaction were found in the muscle hardness, the range of motion, and the muscle tightness ($p < 0.05$). Under the both treatment, the muscle hardness and the muscle tightness significantly changed after the treatment compared the baseline level ($p<0.05$). The changes in the muscle hardness significantly correlated with the changes in the range of motion and the changes in the muscle tightness, regardless of the type of the treatment.
Discussion
The results of present investigation revealed that acute changes of the muscle hardness, caused by the acute local heating/cooling, could predict the changes in the range of motion and the changes in the muscle tightness in the collegiate soccer players.

LOCAL CONTINUOUS KNEE-COOLING AFFECTS FUNCTIONAL HOP PERFORMANCE.

TASSIGNON, B.1, SERRIEN, B.2, BAEYENS, J.P.2, MEEUSEN, R.1
VRIJE UNIVERSITEIT BRUSSEL

Introduction
Muscular strength decreases when local cooling is applied longer than 20 minutes (Bleakley et al., 2012). However, no consensus exists on the influence of local cooling on functional exercise performance skills. Therefore, the aim of this study was to examine the effect of 2 continuous knee-cooling protocols on 2 functional hop tests.
Methods
Twenty healthy male subjects (age = 24 ± 3 years, length = 181.9 ± 6.99 cm, weight = 76.05 ± 9.53 kg) with no history of injury or surgery to the lower extremity were included in this cross-over study and randomised in either the 10 °C-group or the 18 °C-group. Participants came to the lab twice: on day one the dominant leg underwent the cooling intervention and on the second day the non-dominant leg. A kneepad was used to administer continuous cooling during 1 hour. Skin temperature (Tsk) was registered every 10 minutes with skin thermistors placed between the cooling pad and the participants' skin. The single leg hop for distance (SLHD) and the 6-meters single leg crossover hop for time (6mSLCHT) were performed every time before and after the cooling procedure. Normality was checked, repeated measures ANOVA's were used to analyze the effect of cooling, cooling protocol and leg dominance. Follow up tests were performed where needed ($p < 0.05$).
Results
Tsk was significantly reduced after 60 minutes for both the 10 °C-protocol ('Delta' Tsk = 15.22 ± 0.22 °C; $p < .000$) and the 18 °C-protocol ('Delta' Tsk = 8.82 ± 0.22 °C; $p < .000$). SLHD-jump distance significantly decreased in the 10 °C-group by 17.85 cm ($p = 0.004$), however no difference in jump performance was observed in the 18 °C-group ($p = 0.302$). Also, 6mSLCHT-performance significantly deteriorated in the 10 °C-group by 0.37 s ($p = 0.002$), however no significant difference was found in the 18 °C-group ($p = 0.582$). No effect of leg dominance was found in both the SLHD ($p = 0.213$) and 6mSLCHT ($p = 0.705$).
Discussion
Functional performance deteriorated in both hop tests after 1 hour of continuous knee cooling at 10 °C. However, an 18 °C-protocol did not appear to have an influence on functional hop performance. The cooling-induced peripheral neuromuscular inhibition was similar in the dominant and non-dominant leg, since hop performance did not differ between both legs within the same cooling condition. Overall, one should try to avoid the application of cooling before exercise, not only because of its detrimental effects on performance, but also because of the probability of increasing injury risk.
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Mini-Orals

MO-PM26 Training and performance in the elderly

AUTONOMIC REGULATION IN PHYSICALLY FIT AND RECREATIONALLY ACTIVE YOUNG AND OLDER MEN

KONISHI, M.1, KAWANO, H.2, TABATA, H.1,3, KIM, H.K.3, XIANG, M.1, SAKAMOTO, S.1

1: WASEDA UNIVERSITY, 2: KOKUSHIKAN UNIVERSITY, 3: RESEARCH FELLOW OF THE JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE

Introduction
Aging is related to increased sympathetic tone with parasympathetic withdrawal (Kaye and Esler 2008). Physical fitness is positively associated with parasympathetic regulation (Tulppo et al., 1998). Most studies have measured autonomic regulation by heart rate variability (HRV) or noradrenaline as indexes of parasympathetic or sympathetic regulation. Although diving bradycardia reflects vagal regulation, a previous study reported that physical fitness was not associated with bradycardia in young men but bradycardia was attenuated in unfit older men (Petrella et al., 1999). However, they did not measure any reliable index of autonomic regulation such as HRV and noradrenaline. Therefore, we investigated autonomic regulation using HRV, noradrenaline, and diving bradycardia in fit and recreationally active young and older men.
Methods
Fit young (n= 8; age, 21 ± 1 years; peak oxygen uptake, 65.1 ± 5.7 ml/kg/min), recreationally active young (n= 11; age, 25 ± 3 years; peak oxygen uptake, 46.4 ± 5.7 ml/kg/min), and older men (n= 11; age, 69 ± 4 years; peak oxygen uptake, 33.2 ± 4.2 ml/kg/min) participated in this study. The 5-min electrocardiogram data collected in a supine position were used for HRV analysis. High-frequency (HF) power of HRV reflects parasympathetic regulation. The diving reflex test was performed in the sitting position with the face immersed in cold water (0-5 °C) and apnea at mid-inspiration for 30 sec. Diving bradycardia was defined as the relative change in the R–R interval between the baseline and peak response due to the test. The blood sample for noradrenaline was collected at rest after an overnight fast.
Results
Fit and recreationally active young men showed significantly higher HF values and diving bradycardia than older men. However, there was no difference in HF values and diving bradycardia between fit and recreationally active young men. The concentrations of noradrenaline were significantly higher in older men compared with fit and recreationally active young men.
Discussion
The present study suggests that differences in fitness level between physically fit and recreationally active young men does not influence the autonomic regulation measured by HRV, noradrenaline, and bradycardia in young men. Aging appear to decrease both HRV and bradycardia as an index of parasympathetic regulation.
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Contact
m.konishi@aoni.waseda.jp

IS THE FUNCTIONAL TRAINING AN ADDED VALUE TO AGED POPULATION PHYSICAL FITNESS?

BEZERRA, P.1.2, GUIMARÃES, C.3, CAMÕES, M.1, MARTINS, J.2,3

1: IPVC (PORTUGAL); 2: CIDESD (PORTUGAL), 3 UBI (PORTUGAL)

Introduction
Literature has showen the positive effects of systematic physical activity on senior physical fitness. Proposed training methods have included strength and cardiorespiratory exercises. However, little is known about the effect of functional training on physical fitness. Therefore, the aim of this study was to investigate the impact of the functional training, as additional training session, on regular physical fitness status, on seniors.
Methods
Clinical trial with 40 participants, with a mean (sd) age of 71.9 (6.3) yrs and BMI of 28.9 (3.4) kg/m2), divided into three groups according to their physical activity patterns, all above 65 years of age and with a similar distribution on gender. The control group (CG) with no exercise; experimental group 1 (EG1), had a weekly session of exercise; and experimental group 2 (EG2) had two session of physical exercise per week. As part of the intervention plan, it was added a 60' functional training session per week to the experimental groups, for 6 months, in addition to the normal exercises. The physical fitness was assessed, pre and post intervention, as 6 minutes walking test (6MW), Handgrip Test (HT), isometric Knee Extension Test (IKE), and anthropometric measures. ANOVA and T-pair was performed to investigate the physical fitness changes. Significance level was set a $p<0.05$.
Results
At baseline, no significant differences were found between groups on anthropometric measures; EG1 showed lower scores than CG on HG (25.6±4.7 vs 36.8±13.2 Kg, p=0.01) and IKE (29.4±7.5 vs 36.8±13.2 Kg, p=0.02) and lower scores than EG2 on 6MW (444±60 vs 554±105 m, p<0.01). However, the within-group effects, from pre to post intervention, significant differences were found on experimental groups, on EG 2 (HG: 29.9±10.5, 32.0±9.5 Kg, p=0.01; waist circumference (WC): 97.5±8.1, 94.2±7.2, p<0.05) and EG1 (6MW: 444±60, 498±36 m, p<0.01; WC: 97.8±9.9, 94.7±8.3, p<0.02), but not on CG (BMI: 27.8±3.4, 28.4±3.4, p=0.04).
Discussion
Despite having different week workload, experimental groups experience similar impact with the additional functional training session. In fact, looking at the changes within groups the intervention plan promoted significant improvement, namely EG2, suggesting a significant dose response, with more exercise reflecting in significant better adaptations on important cardiovascular risk factors, as the grip strength and waist circumference cases. CG shows any significant change except the increased BMI, after 6 months of no exposition. Functional training may be an important method to improve physical fitness on seniors who trained systematically. However, it is suggested that Functional Training be further examined for its validity as good training method on improving senior physical fitness.

EFFECTS OF EIGHT-WEEK MODERATE INTENSITY BODYWEIGHT EXERCISE ON WEIGHT LOSS AND FUNCTIONAL FITNESS IN ELDERS

YANG, K.
UNIVERSITY OF TAIPEI

Introduction
With increasing age, the function of human body will gradually decrease. It tends to cause low fitness level and high obesity rate. Regular physical activities have been revealed several benefits in physiology and psychology. To increase physical activities, bodyweight exercise is a safe and effective way to executed. Therefore, the aim of this study was to investigate the effects of eight-week moderate intensity bodyweight exercise on weight loss and functional fitness in elders.
Methods
20 elders (73 ± 5.8 years) were recruited to the eight-week moderate intensity bodyweight exercise program, and the exercise session were executed twice a week. Each session involved 12 min warm-up followed by 30 min bodyweight exercise and 12 min cool-down. Heart rate was monitored during the exercise session.
Results
The significant differences were observed between baseline and post-exercise test in the weight (63.6 ± 10.1 and 62.71 ± 9.77 kg), waistline (87.1 ± 8.47 and 83 ± 7.2 cm), chair stand test (19.4 ± 6.1 and 23.5 ± 6.2 kg), arm curl test (21.2 ± 5.9 and 27.6 ± 5.9 kg), 2-minute step test (118.8 ± 20.3 and 130.7 ± 18.8 kg), back scratch test (R't -0.5 ± 7.7 and 4.0 ± 5.0, L't -6.6 ± 10.0 and 5.9 ± 1.6 kg, $p < .05$). In sit and reach test was no significant difference ($p > .05$).
Discussion
After eight weeks exercise intervention, weight loss, muscle strength, cardiovascular endurance can be improve, but flexibility did not. For reaching the comprehensive physical fitness promotion, we suggest the exercise prescription might need to extend the period or mix different types of exercise in the future.
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NORDIC WALKING CAN BE INCORPORATED IN THE EXERCISE PRESCRIPTION TO INCREASE AEROBIC CAPACITY, STRENGTH AND QUALITY OF LIFE FOR ELDERLY: A SYSTEMATIC REVIEW AND META-ANALYSIS

BULLO, V., GOBBO, S., VENDRAMIN, B., DUREGON, F., BERTOLDO, A., ZACCARIA, M., BERGAMIN, M., ERMOLAO, A.
UNIVERSITY OF PADOVA

Introduction
The worldwide increase of old people is associated with the requirement of new strategy for the management of their needs, with particular attention to the preservation of functional capacity and promotion of their quality of life. Physical activity is strongly recommended to elderly population, and its positive key-role in age-related physical declines, is associated to the enhancement of quality of life.
Methods
Keyword "Nordic Walking" associated with "elderly", "aging", "old subjects" and "aged" were used in the online database Medline, Embase, PubMed, Scopus, PsycINFO and SPORTDiscus. Only studies published in peer-reviewed journals written in English language were considered. A meta-analysis was performed and effect sizes (ES) calculated.
Results
Appling inclusion and exclusion criteria, 9 studies were considered eligible for this review. Sample sizes ranged from 18 to 95 subjects, aged more than 60 years. Intervention lasted from 6 to 35 weeks, with a frequency of 2 or 3 times per week.
Discussion
Comparing with a sedentary group, ES showed that Nordic Walking improves dynamic balance (0.25), functional balance (0.62), muscle strength of upper (0.74) and lower limbs (0.22), aerobic capacity (0.9), cardiovascular outcomes (0.23), gait analysis (0.23), body composition (0.25) and lipid profile (0.43), while seems that Nordic Walking has a negative effect on static balance (-0.72). Comparing with a Walking Training, ES showed that Nordic Walking improves dynamic balance (0.3), flexibility of lower body (0.47) and quality of life (0.53), while Walking Training is more effective in improving aerobic capacity (-0.21). Comparing with Resistance Exercise, ES showed that Nordic Walking improves dynamic balance (0.33), muscle strength of lower body (0.39), aerobic capacity (0.75) and quality of life (0.93), while resistance exercise is more effective in increasing the flexibility of upper body (-0.41). Nordic Walking can be considered as a safe and accessible form of aerobic exercise for elderly population, able to improve physical fitness and quality of life. Our results indicate that clinicians who consider Nordic Walking for exercise prescription are suggested to recommend it at least twice per week, at moderate to vigorous rate of perceived exertion (from 13-14 to 15-16) depending on current conditioning, and to add supplemental flexibility and strength exercises, especially for the lower limb.

EFFECTS OF LINEAR PERIODIZATION AND DAILY UNDULATORY PERIODIZATION ON FUNCTIONAL CAPABILITY IN ELDERLY WOMEN

SILVA, S.C.S., SIQUEIRA-FILHO, M.A., CABIDO, C.E.T., PIRES, F.O., LEITE, R.D.
FEDERAL UNIVERSITY OF MARANHÃO

Introduction
The functional capacity impairing during aging have been associated with strength levels decline. In this sense, the resistance training (RT) program can be used as efficiently exercise modality to improve strength levels and consequently functional capacity. However, is not clear the effect of different periodization on elderly functional capacities. Thus, the aim of the present study was to analyze the effect of linear and daily undulation resistance training periodization design on sedentary elderly women functional capacity.
Methods

Twenty two sedentary elderly (64±3 years) were divided into two experimental groups linear (LP; n=12; week 1-4 (3setsX10-12 reps/ rest:60s); Week 5-8 (3setsx6-8reps/rest:90s); week 9-12(3setsx3-5reps/rest:120s)) and daily undulatory periodization (DUP; n=10; week 1-12 (monday: 3setsx10-12reps (rest:60s)/ Wednesday: 3sets x 6-8reps(rest:90s)/ Fridays: 3setsx3-5reps (rest:120s)). The participants were adapted to RT protocol to the exercises (3 sessions) and RT period was perfomed three times (monday, wednesday and fridays) per week during 12 weeks. Time Up & Go (TUG), Timed sit test (TST-30s), vertical Jump test and shuttle run (SR) were used to evaluated functional capacity. Submaximal strength was analyzed in the follow exercise: Horizontal Leg press (HL), Leg extension (LE) and Leg curl (LC) (Radaelli et al., 2015).
Results
The results were presented as delta (Δ), effect size (ES), and demonstrated better functional capacity after resistance training period: TUG (ΔLP=-1.08±1.44; ΔDUP=-1.70±1,15), TST (ΔLP=4.5±5.26; ΔDUP=6.90±2.37), VJT (ΔLP=2.20±3.42; ΔDUP=3.10±1.62), SR (ΔLP=-1.00±0,85; ΔDUP=-1.10±0,99) and 10RM to HL (ΔLP=33.83±18.20; ΔDUP=19.42±13.77), LC (ΔLP=24.18±3.81; ΔDUP=23.61±6.59) e LE (ΔLP=35.53±7.54; ΔDUP=33.06±7.94). The effect size increased, respectively, to DUP (TUG= -2.07, and TST= 4.69), and LP (HL= 2.35). No statistically difference was observed between periodization models.
Discussion
Functional capacity improved can to promote higher daily physical activity levels and lower fall risk among older adults. This study suggests that both periodization models were effective in improving functional capacity and lower limb strength in elderly. DUP promotes a different stimulus with higher frequency compared with LP periodization, what can explain better results for this periodization type. Corroborating our results, Prestes et al (2012) demonstrated that DUP improved functional capacity (TUG and TST) and Lower Limb submaximal strength (8 RM).
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Contact
suramasilva@hotmail.com

EFFECTED OF ISAAN DANCE ON PHYSICAL PERFORMANCE IN THAI ELDERLY: A RANDOMIZED CONTROLLED TRIAL.

SRIRAKSA, C.1, SAWANYAWISUTH, K.2, SRISAMAI, T.3, JANYACHAROEN, T.4

KHONKAEN UNIVERSITY

Introduction
Elderly people are increasing continuously in several countries. Anatomy and physiology of the elderly may change and reduce physical performance. This study was investigated the effect of Isaan dance on physical performances in Thai elderly.
Methods
Twenty-nine subjects divided into two groups. The control group (CG) (n=10) did not undergo Isaan dance exercise but received health education and remained their activity daily livings. The traditional Isaan dance group (TIG) (n=10) received traditional Isaan dance program for 3 times per week, 60 min per time for 12 weeks. All subjects were measured baseline characteristic; weight, height, heart rate, blood pressure, 6 minute walk test and physical performances before and immediately after the program (12 weeks).
Results
After 12 weeks of the study are tester for mobility and stability in the cardiovascular system (6MWT) showed compared in CG associated with before and after that study showed the cardiovascular from the baseline after TIG increased similarly to other aerobic exercise in female subjects with average age of 65 had longer 6MWT with a 6 weeks course of Thai dance compared with control subjects (416 vs 345 m), while COPD patients also had longer walking distance after training exercise (381 to 487 m) (Janyacharoen et al., 2009; Janyacharoen et al., 2011; Janyacharoen et al., 2013). These 6MWT improvements were explained by aerobic exercise in the elderly and also COPD patients (Borghi et al., 2009).
Discussion
These fourth outcomes were also significantly improved from the baseline and control subjects after the 12 weeks of intervention. At the end of study, both TUGT and FRT in control subjects were significantly worse than the baseline. These data indicated that mobility and stability were improved by Isaan dance and worsen without exercise or dance in the duration of 12 weeks. The strengths of this study is the study of design of randomized controlled trial which provide equality of both groups. However, the results of this study may be applied for only healthy elderly subjects regardless of both genders. In conclusion, Isaan dance is appropriate for the healthy elderly subject. Physical performance significantly improved after 12 weeks – course of Isaan dance.
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Contact
yodasung@hotmail.com

IMPROVEMENTS IN EXECUTIVE FUNCTION MIGHT IMPROVE LONG TERM ADHERENCE TO EFAM-UV© NEUROMOTOR TRAINING PROGRAM

CORDELLAT, A., MONTEAGUDO, P., ROLDÁN, A., BLASCO-LAFARGA, C.

UNIVERSITY OF VALENCIA, SPAIN

Introduction
Movement improves Executive function (EF) (Law et al., 2014), a multifactorial capacity related to independence in daily living activities which declines with aging (Yogev-Seligmann et al., 2008). Despite it, elderly's physical activity (PA) adherence is poor, limiting its benefits (Hawley-Hague et al., 2016). This study aims to assess changes in EF in some elderly following EFAM-UV©, a neuromotor and multicomponent training program (MCTP) developed in the University of Valencia, because higher scores in EF after PA programs seem to promote better adherence, at least one year later (Best et al., 2014).
Methods

14 healthy elderly (73.43±7.25 y; 67.84±10.57 kg) completed three years of EFAM-UV©. Changes in EF were assessed by means the Stroop test (Comalli Jr. et al. 1962), getting the time to complete 100 items and the number of elements properly named in 45 s (part C). T-test for related samples were conducted looking for pre-post comparisons, year by year.
Results
Named showed significant pre-post differences during the three years, improving the two firsts (1st: 29.22±9.6 vs 36.89±11.1, p=0.009, t=-3.45; 2nd: 29.22±9.6 vs 36.89±11.1, p=0.009, t=-3.45), and worsening later (3rd: 37.79±12.05 vs 33.86±8.65; p=0.004; t=1.743). Time results failed to reflect this improvement during the first year (151.2±24.65 vs 148.6±19.65; p=0.225; t=0.309) and was therefore abandoned.
Discussion
EFAM-UV© confirms to improve EF along its two first years in our small sample, in agreement with Best et al. (2014) studies. However, the third-year EF declines, a stagnancy that may be due to natural aging, but also to some continuity in the constraints which need to be changed to be still demanding. This might be an important matter in the long term to maintain adherence. However, the 14 elderly in this sample still follow the program, probably because it is well structured, supervised and still challenging. And because it has shown to improve also the physical function after one year in larger samples (Cordellat et al., 2017). Finally, "named scores" more than "time" point to be better for EF assessment after neuromotor MTCP in these populations.
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COMPARISON WITH THE STANDARDS TO ANALYSE PHYSICAL IMPROVEMENTS AFTER EFAM-UV© NEUROMOTOR TRAINING PROGRAM

ROLDAN, A., CORDELLAT, A., MONTEAGUDO, P., BLASCO-LAFARGA, C.
UNIVERSITY OF VALENCIA

Introduction
Multicomponent training programs (MCTP) are one of the most successful strategies to improve health in the elderly (Bouaziz et al., 2016). However, the interpretation of these improvements remains unclear due to big heterogeneity in these populations (Foebel et al., 2016). Normative scores such as those from the Senior Fitness Test (Rikli & Jones, 2013) might become helpful to analyze them, so the present study aims to clarify changes in physical function (lower body strength, cardiovascular fitness and agility) in a group of elderly following EFAM-UV©: a neuromotor, functional and cognitive MCTP developed in the University of Valencia.
Methods
52 healthy elderly (74.16±6.27 years; 68.65±12.40 Kg) completed nine months of EFAM-UV©. Chair stand test (CST), 6min walking test (6MWT) and the timed up and go test (TUGT) were assessed, setting three categories according to Rikli & Jones (2013) normative scores. That is: below (B), standard (S) and above (A) their functional ranges, considering age and gender. Changes in the distribution were analyzed by the Fisher´s exact test.
Results
CST distribution (%) improved from pre to post sampling condition (53B, 5S & 42A vs 25B, 6S & 69A); similarly to 6MWT (46B, 20S & 34A vs 18B, 6S & 76A) and TUGT (82B, 9S & 9A vs 38B, 11S & 51A), always significantly ($p<0.01$).
Discussion
Structured MCTP represent a useful opportunity to optimize results (Gallè et al., 2016). Comparisons regarding the standards explained that the improvements already shown by EFAM-UV© (Cordellat et al., 2017) were meaningful. In fact, elderly changed from below to above the standards. Besides, elderly showed low physical scores previous to EFAM-UV©, confirming losses in physical function in sedentary populations (Sardinha et al., 2015). This is remarkable for agility, an important mixed quality integrating neuromuscular and cognitive demands (Donath et al., 2016) that allows to maintain physical independence (Pereira et al., 2016).
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ASSOCIATION OF PHYSIOLOGICAL CHANGES IN OLDER TAXI DRIVERS WITH MOTOR VEHICLE ACCIDENT INCIDENCE

LAU, L.K., ONG, A., CHAN, Y.H., DIXON, J., HAMILL, J., JAGADISH ULLAL, M., MARTIN, D., SEAH, H.S.
REPUBLIC POLYTECHNIC

Introduction
The age limit for taxi drivers in Singapore is extended to 75 years old. There is increasing concern over the occurrence of motor vehicle accident (MVA) among the older drivers due to degeneration of biological system. This study aimed to examine the association of physiological changes with MVA incidence in taxi drivers.
Methods
Twenty-five taxi drivers (55.4±4.7 years old) participated in this study. The number of MVA encountered by drivers was recorded. Drivers' physical activity level was assessed using Global Physical Activity Questionnaire. Physical assessments, cervical rotation range of motion, eye movement speed, gaze stability and sequential head-eye movement were conducted on the drivers. Standard multiple regression

was used to assess the association of age, physical activity MET, cervical rotation mobility and head-eye coordination with the occurrence of MVA in drivers.
Results
The results showed that age, physical activity MET, cervical rotation mobility and head-eye coordination tests explained for 42.8% of the variance (Adjusted R^2=0.43, $F(7,17)=3.6$, $p<0.05$). Age, B=0.09 (95% CI, 0.02 to 0.17), physical activity MET, B=-0.001 (95% CI, -0.001 to 0.00), right cervical rotation, B=0.04 (95% CI, 0.01 to 0.08) and gaze stability, B=0.66 (95% CI, 0.09 to 1.23) were significantly associated with MVA incidence in the drivers ($p<0.05$).
Discussion
This study is in agreement with the established positive association of increasing age with incidence of MVA in drivers (Barr, 1991). Driving in the left-hand traffic condition, drivers possibly spend more time looking to the right (Kandil, Rotter & Lappe, 2009), which may lead to increased right cervical rotation mobility. This in turn reduces left visual field of the elderly, exacerbated by the reduction of horizontal peripheral visual field with age. Degradation of the vestibulo-ocular reflex with aging, especially during fast head acceleration could possibly cause poor gaze stability in the drivers and explain for its association with higher MVA incidence. Future studies on gaze tracking during actual driving conditions may be done to further investigate the ecological validity.
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Contact
charlene_lau@rp.edu.sg

Mini-Orals

MO-SH01 Health and fitness in children

SEDENTARY TIME IN GERMAN PRIMARY SCHOOL CHILDREN

HOFFMANN, B., KETTNER, S., WIRT, T., WARTHA, O., HERMELING, L., STEINACKER, J.M., KOBEL, S.
DIVISION OF SPORTS AND REHABILITATION MEDICINE

Introduction
Sedentary behavior in children is related to different health consequences such as overweight and cardiovascular diseases that can track into adulthood. Thus, hours are spent being sedentary daily and only every other child in Germany meets the physical activity guideline of the WHO. This study investigated the amount and potential predictors of sedentary time (ST) such as physical inactivity, weight status, and different socio-demographic factors in a sample of primary school children in south-west Germany.
Methods
Children's physical activity (PA) was measured for one week objectively using a multi-sensor device (Actiheart, CamNtech, Cambridge, UK). Energy expenditure was calculated in metabolic equivalents (MET). Activity levels were categorized into sedentary, light PA, and moderate to vigorous PA (MVPA). ST was assessed for 231 children (7.1 ± 0.6 years, male: 45.9%). Children were classified as inactive when not reaching the WHO guideline of 60 minutes of MVPA daily. Weight status was calculated in BMI percentiles. Examined factors such as parental education, household income and migration background were collected by parental questionnaire. T-tests were performed to find group differences and a linear regression model was used to identify associations.
Results
On average, children spent 3.5 ±1.5 hours being sedentary per day. Significantly higher ST was found for girls ($t= -4.6$; $p\leq0.01$), in children with migration background ($t= -6.9$; $p\leq0.01$), on weekend days ($t= -2.8$; $p\leq0.01$), and among inactive children ($t= 6.8$; $p\leq0.01$). In addition, identified significant associations with ST were not reaching the WHO activity guideline (0.365; [39.0; 90.5]) and being migrant (0.161; [4.8; 61.5]).
Discussion
On weekends, among girls, children with migration background and inactive children ST is higher. As sedentary behavior is a well-known health risk factor these children therefore can be at higher health risk. Additionally, as children's daily PA is associated with their sedentary amount, daily PA might be a potential reducing factor for ST. But further research is necessary. Finally, ST in our sample is lower than in other countries' primary school children, which could point to different conditions and resting metabolism. Therefore, further research also on the amount is necessary.

PHYSICAL ACTIVITY LEVEL AND SEDENTARY BEHAVIOUR AMONG HEALTHY SCHOOLCHILDREN IN SPAIN MEASURED BY TRIAXIAL ACCELEROMETRY

BENÍTEZ-PORRES, J., LÓPEZ-FERNÁNDEZ, I., ALVERO-CRUZ, J.R., CARNERO, E.A.
UNIVERSITY OF MÁLAGA

Introduction
Physical inactivity and sedentary behaviour has been identified as risk factors of childhood obesity and cardiovascular diseases. Triaxial accelerometers provide an objective indicator of free-living physical activity (PA). The purpose of this study was to describe levels and patterns of PA and sedentary time (ST) in Spanish children.
Methods
Data from 316 (n=166 boys, n=150 girls) healthy students (Age: 11.1±1.3 years; BMI: 19.8±3.6 kg/m2) enrolled in fourth, fifth or sixth grade, from the south, central and north of Spain, were used. The Actigraph GT3X monitor device was used to assess PA. Accelerometers were set to register 1-second epoch cycles, and were programmed to assess 7 days. We selected the cut points from Evenson et al. to determine the time spent on different intensity levels of PA and ST.
Results
Accelerometer data revealed that children spent an average of 54.4±17.8 min/day in moderate-to-vigorous PA (MVPA) and were sedentary for an average of 10 hours per day (619.2±67.3 min/day). Accumulation of 60 min/day of MVPA was achieved by 37.7% of the stu-

dents. There was a significant difference in MVPA and ST between boys and girls (MVPA 58.3±16.9 vs 49.9±17.7 min/day, p<0.001; ST 609.8±66.1 vs 629.6±67.4 min/day, p<0.01; respectively). Boys performed 9865 steps/day, while girls performed 9119 steps/day (p<0.05).
Discussion
Our results suggest that a high percentage of Spanish schoolchildren do not meet PA and daily steps recommendations, where boys are more active than girls. Children spent most of their time in sedentary activities and light PA. Spanish government should consider launching campaigns against sedentary behaviour in schools in order to increase MVPA daily level.
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Contact
benitez@uma.es

PHYSICAL FITNESS AND PROPORTION OF PHYSICAL FITNESS GIFTEDNESS IN THIRD GRADERS LIVING IN THE FEDERAL STATE OF BRANDENBURG, GERMANY: A COMPARISON OF THE 2011 AND 2015 COHORT

GOLLE, K., GRANACHER, U.
UNIVERSITY OF POTSDAM

Introduction
Physical fitness (PF) tests are an effective means to identify talents and to evaluate the health status of youth. However, secular declines in PF have previously been reported for youth. Thus, the aims of this study were to compare PF data from third graders in 2011 and 2015 and to evaluate whether the proportion of gifted children according to PF differs between both cohorts.
Methods
Within the state of Brandenburg (Germany), 9,372 third graders (♀ 48.2%; 8.6±0.5 years) were tested for their PF in 2011. In 2015, a cohort of 9,820 third graders (♀ 49.5%; 8.8±0.5 years) was evaluated. Students performed the 20-m sprint test (speed), the 1-kg ball push and standing long jump test (upper/lower-extremity muscular power), the stand-and-reach test (flexibility), the star agility run test (agility), and the 6-min run test (endurance) during regular physical education classes.Two categories of PF giftedness were defined using identical sex- and age specific norm values for both cohorts: i. 'overall PF giftedness' (scores in four out of 6 PF tests belong to the highest fitness quintile while the remaining 2 test scores belong at least to the 3rd quintile; ii. 'specific PF giftedness' (the score in one test belongs to the top 3% according to norm values).
Results
Irrespective of sex, the 2015 cohort performed significantly better in the 20-m sprint and the 1-kg ball push test (all p<.001; 0.08≤d≤0.14). Impaired 6-min run test performance was found for the 2011 cohort (p<.001; 0.11≤d≤0.15). No significant between-cohort differences were detected for the remaining PF tests. In terms of overall PF giftedness, a higher proportion of students fulfilled this criteria in 2015 compared to 2011 (4.5 vs. 5.2 %; p < .05). A significantly larger proportion of the 2011 than the 2015 cohort achieved the category specific PF giftedness for agility (3.0 vs. 2.3%; p<.01) and endurance (3.3 vs. 2.4%; p<.01), while proportion of specific PF giftedness in the remaining test items were equal between both cohorts (p > .05).
Discussion
Our analyses revealed lower endurance-capacity and better speed- and upper-body power PF in the 2011 compared to the 2015 cohort. Thus, aerobic capacity may have declined while anaerobic capacity may have improved. However, the identified small effect sizes indicate rather robust PF levels. The larger proportion of third graders categorized as overall gifted in 2015 is of importance because it indicates diversified motor experiences resulting in higher overall PF levels. This is meaningful for the general youth population with regards to the development of physical literacy and for youth athletes in terms of a successful start into long-term athlete development.

BLOOD VALUES AND AEROBIC POWER IN SIX-YEAR OLD CHILDREN

MAMEN, A.1, GAMMELSRUD, H.2, HJELLE, O.P.1, LINDBERG, M.3, FREDRIKSEN, P.M.1
1KRISTIANIA UNIVERSITY COLLEGE, 2FACULTY OF MEDICINE, UNIVERSITY OF OSLO, OSLO, 3CENTRAL LABORATORY, VESTFOLD HOSPITAL TRUST, TØNSBERG

Introduction
For adults there is a correlation between [Hb], number of erythrocytes (ERY) and maximal aerobic power. Similar associations in children are less documented. The aim of this study was to see if [Hb], ERY, and the quantity of iron and ferritin are associated with aerobic power in children.
Methods
120 1st grade pupils took all the tests. Blood samples from the antecubital vein were collected in non-fasting state. [Hb] and ERY were measured with Sysmex XE 2100 analyser (Sysmex Europe GmbH, Noderstedt, Germany). Iron was measured on Vitros 5600 analyser (Ortho-Clinical Diagnostics, Raritan, NJ, USA). Ferritin was measured on an Architect i2000SR (Abbott Diagnostics, Lake Forest, IL, USA. Aerobic power was measured with the Andersen intermittent running test (1) and with a maximal treadmill test measuring the oxygen uptake with a Cosmed K4b2 analyser (Cosmed S.r.l., Roma, Italia). Peak heart rate (HRpeak) was registered with a Polar Heart Rate Monitor (Polar Electro OY, Kemple, Finland).. Statistical analyses were performed using IBM SPSS v. 21 (IBM Corporation, Software Group, Armonk, New York, USA).
Results
Analysis showed a significant, but weak correlation between the [Hb]• and Andersen running test results (r = 0.193, p = 0.018). No significant correlation was found between the Andersen test and ERY (r = -0.095), [iron] (r = -0.106) or [ferritin] (r = 0.149). For oxygen uptake, both relative (ml•kg-1•min-1) and (ml•kg-67• min-1) and absolute (L•min-1), there were no significant correlation between [Hb], ERY, [iron] or [ferritin].
Discussion

Only weak correlations were found between blood parameters and the performance in maximal endurance tests. This may be explained by the difficulty children of this age have in performing challenging tests that require them to sustain discomfort for a considerable period of time. Also walking/running on a treadmill is difficult and for some a scary experience. The Andersen test requires the children to plan their pacing, which is not easy. The test was only done once and others have shown that two or three runs are needed to obtain a stable result (2). For these reasons, it is problematic to investigate the relationship between blood variables and maximal endurance performance in six-year old children.

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Contact
asgeir.mamen@kristiania.no

PARTICIPATION IN COMMUNITY-BASED HEALTH PROMOTION PROGRAMS HAS BENEFICIAL EFFECTS ON BODY COMPOSITION AND FITNESS IN EARLY CHILDHOOD

FERRARI, N.1, FRIESEN, D.2, LUETKEMEIER, L.2, SCHWAMBORN, J.2, DREISKAEMPER, D.3, NAUL, R.3, GRAF, C.2

1: UK COLOGNE (COLOGNE, GERMANY), 2: DSHS (COLOGNE, GERMANY), 3: WWU (MUENSTER, GERMANY)

Introduction
Health promotion in childhood is a major concern of public health and should be implemented at community-based level. Aspects of infrastructure in prevention networks remain entirely neglected within the scientific context. Therefore, we analyzed (among others) the association between the current status quo and acceptance of health promotion programs for preschool and primary school children at baseline (t0) and after one year (t1) with health parameters (body composition) and motor skills in different areas of Cologne, Germany.
Methods
585 children (51.8% male) with a mean age of 6.7 +/- 1.7 years who lived either in a deprived or non-deprived area participated in this study between September 2015 and July 2016. Body composition was assessed by BIA (Nutrigard S) and BMI (kg/m2). Fitness level was measured using shuttle run test (kindergarten) and 6-min run test (primary school). Participation in health promotion programs (nutrition and physical activity) was assessed by standardized questionnaires for parents.
Results
Children living in deprived areas participate less often in health promotion programs than children who live in non-deprived areas (60.6% vs. 39.4%; p<0.001). However, participation in health promotion programs at baseline is correlated with children's BMI (r=-0.108; p=0.006), body fat mass (r=-0.148; p<0.001) and 6-min-run (r=0.106; p=0.019). After one year it has been shown, that children who participate in health promotion programs gain less body fat mass (0.5 +/-1.2 kg vs. 0.2 +/- 1.2 kg; p= 0.011, adjusted for age, area and baseline data; partial eta-squared= 0.012), increase less in BMI (0.4 +/- 0.8 kg/m2 vs. 0.3 +/- 0.7 kg/m2; p=0.030, adjusted for age, area and baseline data; partial eta-squared= 0.08), and have higher running performance compared to children who do not participate in health promotion programs (62.7 +/- 85.3 m vs. 36.1 +/- 91.4 m; p<0.001, adjusted for age, area and baseline data; partial eta-squared= 0.027).
Discussion
Participation in health promotion programs seems to have beneficial effects on body composition and fitness in early childhood. Therefore, children should be encouraged to participate in those programs, especially in deprived areas.

Contact
nina.ferrari@uk-koeln.de

MOTOR COMPETENCE ASSESSMENT . FIRST RESULTS FROM A NOVEL ASSESSMENT INSTRUMENT.

RODRIGUES, L.P.1,5, LUZ, C.2, CAMÕES, M.1, LIMA, R.1, GONÇALVES, F.1, LOPES, V.P.3,5, CORDOVIL, R.4

1: INSTITUTO POLITÉCNICO VIANA DO CASTELO (PORTUGAL); 2: INSTITUTO POLITÉCNICO LISBOA (PORTUGAL); 3: INSTITUTO POLITÉCNICO BRAGANÇA (PORTUGAL); 4: UNIVERSIDADE LISBOA (PORTUGAL); 5: CIDESD, PORTUGAL)

Introduction
Motor competence has been widely recognized in literature as a key point to the development of healthy life styles. Recently, Luz, Rodrigues, Almeida and Cordovil1 presented a quantitative model to evaluate motor competence from childhood to the adult age, applicable in research, education, and clinical contexts. This model, composed by three major components representing locomotor, stability, and manipulative skills, was used for establishing the Motor Competence Assessment (MCA), a novel instrument that aims to be able to assess motor competence throughout the life span (children, adolescents, adults, and senior citizens). The main purpose of this presentation is to show the preliminary results of the MCA.
Methods
One thousand and one hundred (1100) participants from 3 years-of-age to adulthood were tested. Six tests were used: ball velocity for throwing, and ball velocity for kicking (manipulative skills); standing long jump, and 10 m shuttle run (locomotor skills); 15 s lateral jumps, and 20 s shifting platforms (stability skills). Results were explored using ANOVA and regression models.
Results
A general effect of age was found for all tests (p<.001), but with different trajectories between sexes (p<.05). Quadratic regression models showed a reasonable explanation of the dependent variables (36%-50% girls, 58%-62% boys). Descriptive representation showed that performance was homogeneous across age groups for all six tests.
Conclusion
As predicted by the model, these six tests were able to differentiate amongst children's manipulative, locomotor, and stability skills proficiency, and this assumption extended to adult age. In conclusion, the MCA instrument show optimistic expectations to be used over the life span without a ceiling effect.

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Luz, C., Rodrigues, L. P., Almeida, G., & Cordovil, R. 2016. Development and validation of a model of motor competence in children and adolescents. Journal of Science and Medicine in Sport, 19(7), 568-572.

THE COMPARISION OF PREDICTIVE MOTOR CONTROL LEARNING IN DEVELOPMENTAL COORDINATION DISORDER AND TYPICALLY DEVELOPING CHILDRENS

AHMADI, M., SEPEHRI, B.H.
ISLAMIC AZAD UNIVERSITY-URMIA BRANCH

Introduction
The purpose of this study was to compare learning of predictive motor control in developmental coordination disorder(DCD) and typically developing children.
Methods
The sampling design was from (aged 7-12 years) male students of Tabriz, 12 children with DCD, and 12 (TD) children (age and IQ matched) were selected. Participants were required to track a target moving along a circular path on a monitor by using game controllers. Predictive control was assessed by Variables which reflecting tracking success and behavior with the manual tracking.
Results
Results of repeated measure of analysis showed that there was a significant difference between DCD and TD children on measures of predictive control; total time on target(p=0/049), consecutive time on target(P=0/016), distance from the target(P=0/002) and velocity of the cursor(P=0/001).
Discussion
Collectively, DCD children had deficits in consolidation and learning of predictive motor control, they used feedback-based step-and-hold strategy, and an underlying deficit in the internal modeling was concluded in DCD children.

DEVELOPMENTAL STUDY OF FUNDAMENTAL MOVEMENT AMONG PRESCHOOL CHILDREN PLAYING HOPSCOTCH

SASAKI, R., ISHIZAWA, J.
KEIO UNIVERSITY

Introduction
Kindergarteners on a playground engage in various locomotor activities. Early childhood is a sensitive period for the development of fundamental movement skills, and then various locomotive movements, such as hopping, galloping, and skipping, increase with age during play. Hopping is a rhythmically cyclic movement that requires significant muscular strength, multi-limb coordination, and dynamic balance in order to be performed proficiently (Gallahue et al, 2012). In this study, we clarified the developmental changes in coordinated movement, focusing on the hopping movement used during hopscotch.
Methods
Participants were typically developed preschool children (160 boys and girls) aged 4–6 years. They were asked to perform a set of rhythmic hopping movements, following a set sequence by hopping in a pattern, approximately 4 meters in length, with either one or two feet. We filmed all of their movements and analyzed the footage. Then, we evaluated every movement from the overall images using the following criteria: 1) completion of the task as a basic movement, and 2) rhythmically controlled and fluent switching of landings from one foot to two, and vice versa, during the task. Mastery of the movement was compared among age groups of children.
Results
The rate of accomplishing the task was higher in older children (>60%) than in younger children (~30%). Older children completed the task sequence with few or no problems. However, younger children had some difficulties, and paused and faltered while executing the sequence. From the observational analysis, older children showed more advanced performance than younger children did. Older children, particularly girls, showed more fluent switching in alternating one-foot and two-feet landings, and had more controlled movement sequences.
Discussion
The preschool and early elementary school years are important for learning and acquiring a good hopping technique (Gallahue et al., 2012). An adequate hopping pattern was shown at around 5 years of age, with girls showing this pattern several months earlier than boys did (Seefeldt and Haubenstricker, 1982). In this study, a noticeable change was observed in preschoolers aged 4–6 years, and a sex difference was observed as well. However, few children were evaluated as advanced because the task, like the hopscotch movement, was supposed to be difficult to follow with the rhythmic alternating changes.
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Contact
sasaki@z6.keio.jp

CORRELATION BETWEEN THE OBSTRUCTIVE SLEEP APNEA SYNDROME, PHYSICAL PERFORMANCE AND PHYSICAL ACTIVE AND INACTIVE LEISURE TIME ACTIVITIES IN JUVENILE OBESITY

RÜSWEG, S., MOITZ, M., MAISONAVE, F., FERRARI, N., GRAF, C.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
The number of obese and overweight children and adolescents has increased substantially in recent years and thus the risk for the obstructive sleep apnea syndrome (OSAS). Conversely OSAS is a risk factor for (juvenile) obesity. The aim of this study was to determine whether there is a correlation between a sedentary lifestyle (media consumption, lack of exercise) and physical performance (relative VO2max) with OSAS.
Methods
38 out of 60 children and adolescents have been recruited for this study (MD 13.1 +/- 1.8 years). Sleep screening (ApneaLink, ResMed) has been examined to detect apnea– hypopnea-index (AHI). AHI > 1 was defined as OSAS. The 20-meter Shuttle-Run-Test by Lèger and Lampert (1982) was used to detect the relative VO2max (ml/Kg/min) to evaluate physical performance. Height and bodyweight were measured and BMI was calculated for anthropometric data. Active and inactive leisure time activities as well as media consumption were measured by standardized questionnaires.

Results
The mean BMI was 30.0 +/- 4.2 Kg/m². 63.2% of the study population had an AHI > 1 (Range 0-7). The mean relative VO2max was 37.6 +/- 4.2 ml/Kg/min, the mean media consumption 4.0 +/- 2.7 hours/day and the mean exercise was 59.0 +/- 47.7 minutes/day. There was an inverse correlation between relative VO2max and BMI (r= -0.486; p= 0.002), additionally the relative VO2max affected the AHI (p= 0.021). The binary logistic regression analysis confirmed 15% of the variance by the VO2max (AHI; ß-Coefficient= -0.195; p= 0.059). In another model 24.8% of the variance was confirmed by the composition of AHI and BMI (VO2max; ß-Coefficient= 0.309; p= 0.005).
Discussion
There is an inverse correlation between physical performance, AHI and BMI, but not between media consumption or physical activity and AHI. A greater BMI has a higher impact on the relative VO2max than a greater AHI has. Longitudinal studies are necessary to detect these causal impacts.
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Contact
S.Ruesweg@dshs-koeln.de

Mini-Orals

MO-SH02 Sports in society: Mixed session

THE ROLE OF HOSTING SPORT EVENTS ON URBAN DEVELOPMENT

HEMATI-MORADABADI, J.1, ESLAMI, S.2
1.ISLAMIC AZAD UNIVERSITY, BEHBAHAN BRANCH.2.PNU IRAN

Introduction
Hosting sport events have gained increasingly popularity and influence among cities. Host cities generally attach great importance to factors such as the event's economic implications, event-related income and the development of tourism (Ottevanger., 2007) .Therefore, the aim of this study was to investigation the role of sport event hosting on urban development.
Methods
The method of this study is descriptive correlation with the practical purpose and is executed through field. The statistical population include; member of the board of directors, sport management experts, urban development and urban planning experts in ministry of roads and municipality city planning and tourism assistance experts. The population size of approximately 1000 was considered. With using of Morgan's table 278 samples were selected by random purposive sampling. The measurement tool in this research was questionnaire and main factors was found by exploratory factor analysis and confirmed by confirmatory factor analysis.
Results
Results showed that the structural model is fit (2X/df=1/96). The result of multiple variable regression showed that sport event hosting was a predictor variable for urban development (R2 =0 /50).and Durbin-Watson statistic Calculated 0/56. Finally role of hosting sporting events on economic development (T=11/37), hosting sporting events on sociocultural development (T=16/29), hosting sporting events on Structural development (T=17/12), hosting sporting events on Ecological development (T=14/65).
Discussion
The variables of urban development that considered in this study includes: economic development, sociocultural development, Structural development and ecological development .Trade liberalization is one of the economic impacts of hosting sporting events (Kim et al.,2015). Host international sporting events with entry into the markets could promote economic indicators such as GDP, export development and branding .And provide favorable conditions for private sector investors by security that created. Hosting sports events led to a positive image of the community, increase cultural exchange, encouraging people to exercise (Chatziefstathiou.,2012) .finally Long-term plans of urban development along with hosting sports events, leading to the selection of suitable locations for the development of sports places, green space, and change urban furniture and urban morphology.
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SPORT AS A CHANCE FOR PUBLIC GERMAN TV

WERTH, M.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Big sport events show how sports fascinate people from all over the world and bring them together. Combining entertainment and information, sports play a unique part in television. Due to the big interest, television stations are highly interested in broadcasting big sport events to reach as many people as possible. However, besides an economic factor, sports can also be a way to convey values to people. This duality makes it interesting for public TV stations and their governmental tasks to affect society.
The aim of the present study is to analyse sports coverage and the ongoing challenges it faces with the introduction of competition between commercial and public TV stations in Germany since 1984, and the challenges of sports itself like doping, corruption and fraud. Additionally, the study tries to identify if journalist feel a responsibility to use sports for more than just generating higher viewing rates.
Methods
Qualitative interviews were chosen to get a deeper insight to the opinion of experts in journalism. Therefore eight interviews with journalists of ZDF, a major public TV station in Germany, were held. The information they gave was on the one hand used to define the central problems journalists are facing when broadcasting high class sports programmes while competing with commercial TV. On the other hand it was used to define quality journalism as an individual responsibility.
Results

The results show that public TV journalists do not only use sports to address people momentarily, they rather try to attract new viewers, especially young viewers and viewers that are not yet frequently watching public TV, for their general programme. Sports are used as a first link to the TV station which can have a long-term impact on peoples values. A good opportunity and the biggest advantage of public TV compared to commercial TV, is using interfaces between news and sports programmes to lead viewers to watching more than their custom sports programmes and so broaden their horizons through sports.
Discussion
Publicly funded TV stations in Germany have to fulfill tasks like contributing to the opinion making or strengthening public solidarity with their programme. Thus they are constantly in need to justify their investments, especially the tremendous amounts that sport events cost. Journalists try to use the potential of sports in their strategy to deliver messages to new viewers. With sports programmes they try to convince even viewers that were not interested in quality journalism before, of its advantages. As fees for broadcasting rights keep rising and public TV stations struggle to justify those expenses, this opportunity is being lost: The first step is the failure to aquire the broadcasting rights to the 2018 and 2020 Olympics by the german public TV stations.

PSYCHOPHYSIOLOGICAL EVALUATIONS ON CARDIOVASCULAR RESPONSE WHILE WATCHING DIFFERENT SKILL-LEVEL KENDO GAMES

HOSHINO, S.

NARA WOMEN'S UNIVERSITY

Introduction
Why do people watch sports games? The deciding factors of sports watching behavior were classified into five factors, 'Communication', 'Attachment', 'Model-Skill', 'Information' and 'Entertainment'. When people watch a game, not only the interest in the game but also the mental processes such as the prediction and expectation for the movement of the player and the game situation are considered to exist. In this research, we examine the relationship between the emotion of spectators and psychophysiological responses, which leads to motivation for sports watching behavior. The purpose of this study was to evaluate the psychophysiological relationship between emotion and a cardiovascular response from the point of different skill-level kendo games.
Methods
Subjects: 12 college-aged women (20.2±1.6 years). They have practiced kendo for 7.8±4.6years.
Procedure: The participants were divided into groups according to their interest in differently leveled kendo games. They were requested to watch three different skill level kendo videos; 1) Easy level: the video of high school players, 2) Middle level: one of amateur high skilled adult players, and 3) High level: one of professional high skilled adult players.
Psychological index: After the end of each video, the participants checked the affect grid, which is configured by the pleasure-displeasure dimension on the horizontal axis and the high arousal - low arousal dimension on the vertical axis. The highest points of pleasant and high arousal are indicated by 9 points, and the lowest points are 1 point.
Physiological indices: a systolic (SBP) and a diastolic (DBP) blood pressure and HR by means of a continuous noninvasive blood pressure monitor during watching the videos.
Results
Higher interest in skill level showed significantly higher arousal and higher pleasant emotion. Moreover, the higher the degree of interest in skill level indicated significantly higher systolic blood pressure and diastolic blood pressure than ones at rest.
Discussion
Those with a high degree of competition showed interest in games with a high level of skill while those with low competition experience showed interest in games with a low skill level.
The interests of game players are closely related to learning model skills from game players. In addition, it became clear that the degree of interest of spectators was observed by the change of blood pressure.
Contact
satoko@cc.nara-wu.ac.jp

ANTICIPATION AND EXPERTISE IN E-SPORTS PLAYERS

KIM, H.

SEOUN NATIONAL UNIVERSITY

Introduction
In e-Sports, the purpose of the players is to respond to single object on the screen as well as to multiple objects simultaneously. The e-Sports players should decide when is appropriate to anticipate for an attack and defense in a competitive situation. Obtaining the anticipation timing performed by professional players is important so that we are able to find out what are the characteristics of e-Sports players. Therefore, the aim of this study was to investigate the perceptual characteristics of e-Sports professional gamers compared to amateurs.
Methods
The expert group consisted of eight professional players and the novice group included eight amateur players. Bassin anticipation timer (Model 50-575, Lafayette) was positioned at the distance of 1.5m away in front of the participants. The LED light stimuli moving at various speeds (1mph, 3mph, 6mph, 9mph) from left to right were given and the participants tried to continue to predict when the stimulus would reach the target point by simply pressing a button. Five familiarization trials for each speed condition were shown and five practice trials were given with feedback. Thereafter, every participant completed the test trials 16 times per speed with no feedback.
Results
The mean value of the expert group was -0.018 and 0.031 for the novice group in the condition of 1mph (-0.023 for experts and -0.007 for novices in 3mph, -0.029 for experts and -0.029 for novices in 6mph, -0.019 for experts and -0.003 for novices respectively). There was no significant difference between the means of speed in the expert group ($F_{3,28}=0.54$ $p=0.657$). There was no significant difference as well between the means of speed conditions in the novice group ($F_{3,28}=2.86$ $p=0.0549$), however very close to being statistically significant. The only statistically significant difference between e-Sports professional players and amateur players was found in the 1mph condition ($p=0.0124$).
Discussion
We predicted that experts would show superior anticipation scores than novices. This study showed that professional e-Sports players seem to be more stable in different speed conditions. The results indicated an inverted-U relationship with an increase of speed. At the

maximum speed of 9mph, both groups of players were more accurate in anticipation rather than the condition of 6mph. Future research should include more speed conditions and more participants with non-playing experience to examine and compare.
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Contact
snu200930415@gmail.com

EFFECT OF 16 WEEKS OF SUPERVISED FARTLEK-TRAINING PROGRAM ON PERCEIVED WELLNESS OF UNIVERSITY STUDENTS OF SAUDI ARABIA

ANTONY, V.C., TOMAR, R.

PE DEPARTMENT, KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS, SAUDI ARABIA

Introduction
Wellness is a multidimensional state of being describing the existence of positive health of an individual as exemplified by quality of life and a sense of wellbeing. The objective of the study was to find out the effect of 16 weeks of supervised fartlek training on perceived wellness of university students of Saudi Arabia.
Method
Forty undergraduate students of King Fahd University of Petroleum and Minerals were selected for the study, mean age 18.52 ± 0.599 years. Two groups were formed randomly into intervention (n=20) and control group. Sixteen weeks of supervised fartlek training program was offered to intervention group; control group (n=20) were asked to continue their daily task without participating in an exercise program. Duration of the training was 45 minutes per session, twice a week. Perceived Wellness Survey (Adams, Bezner, Steinhardt, 1997) administered to assess the perception of students' wellness. Analysis of covariance was employed to find any significant difference in groups after 16 weeks of fartlek training.
Results
A significant increase was recorded after 16 weeks of intervention training program on psychological wellness (p=0. 037), emotional wellness (p=0.004), physical wellness (p=0.033) and spiritual wellness (p=0.014); while no significant difference was observed in social wellness (p=0.305) and intellectual wellness (p=0. 568). Total wellness score improved significantly 3.141 units in the intervention group.
Discussion
The results were consistent with Klepfer (2013), Rouse & Biddle (2010) who reported that physical training increases higher perception of physical health. Emotional health improved with physical activity (Masley et al., 2009). Consistent participation in vigorous physical activity enhanced emotional, psychological and physical health Elliot et al., (2012) and Downs & Ashton (2011). More spiritual and physically active showed greater quality of life, which significantly effects psychological health status, Konopack (2012). Fartlek training program was effective in improving the perceived wellness and creating some positive changes toward healthy life-style habits of Saudi students.
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Contact
vcantony@kfupm.edu.sa

COACHES' PERSPECTIVES ON THE USE AND EFFECTIVENESS OF EXERCISE AS PUNISHMENT

KERR, G., STIRLING, A., BANDEALY, A.

UNIVERSITY OF TORONTO

Introduction
Recent anecdotal and empirical evidence indicates that exercise continues to be used as a coaching strategy to punish athletes for poor performance or behavioural infractions. The use of exercise as punishment runs contrary to several international position statements that condemn its use in sport and physical education settings. The purpose of this study therefore was to investigate coaches' perspectives on the use, frequency, and perceived effectiveness of the use of exercise as punishment.
Methods
Semi-structured interviews were conducted with eight, four male and four female, head coaches of university sport teams. Questions were posed about whether or not coaches used exercise as punishment and if so, how frequently, as well as their views on the effectiveness of this strategy. Four of the participants coached individual sports and four coached team sports. Data were analyzed inductively and thematically.
Results
Results revealed that coaches frequently used exercise as a form of punishment to sanction poor athletic performance and to address behavioural infractions such as being late for practice. The participants perceived exercise as punishment to be an effective coaching strategy for changing behaviour and ensuring compliance with team rules and expectations. Further, these participants were unable to suggest alternative, non-punitive strategies to modifying athletes' behaviours.
Discussion
The findings confirm previous research indicating the common use of exercise as punishment by coaches. The results are interpreted using a relational maltreatment framework (Stirling, 2009), suggesting that the use of exercise as punishment may constitute a form of emotional abuse. Given the movement away from the use of punishment within parenting and educational domains, recommendations are made to educate coaches about alternative disciplinary strategies that teach and guide athletes towards desirable behaviours rather than the punishment of undesirable behaviours.
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15:00 - 16:00

Mini-Orals

MO-PM16 Training and testing in various sports 3

THE ACUTE HORMONAL AND PHYSIOLOGICAL RESPONSE TO KETTLEBELL SWINGS DIFFERS DEPENDING ON LOAD, WHEN TOTAL WORK IS HELD CONSTANT

RAYMOND, L., RENSHAW, D., DUNCAN, M.
COVENTRY UNIVERSITY

Introduction
Kettlebell (KB) exercise is a popular training modality as it results in increased muscular strength and endurance, power, and aerobic capacity (Lake and Lauder, 2012). KB exercise also results in acute increases in hormones important in muscle adaptation (Budnar et al., 2014). No study has examined whether this response differs depending on the load lifted. It is also unclear whether the KB load or total work completed results in a different response. This study examined the acute hormonal and physiological response to KB swings at different loads when total work was held constant.
Methods
Following ethics approval and informed consent, 10 strength trained males (mean±SD training years: 6.6±6y, mean±SD age: 25±6y) participated in this study. 2 trials were completed in a counterbalanced order, with an 8kg and 16kg KB respectively. The protocol comprised 30s KB swings vs. 30s rest for 12min (Budnar et al., 2014). Swing cadence was manipulated in each trial to ensure total weight lifted was the same across conditions. Swing cadence was 84bpm (8kg) and 42bpm (16kg) in the 16kg. Heart rate (HR) and RPE, using the Borg RPE scale 6-20 (Borg et al. 1970), was taken at the end of each 30s exercise bout. Saliva samples (min 0.5ml) were taken 15 minutes pre, post and 15 and 30min post each condition. Cortisol and testosterone levels were assessed via high sensitivity enzyme immunoassay kit (Salimetrics, State College, PA, USA).
Results
A 2(16kg vs 8kg load) X 4(pre, post, 15min post, 30min post) way repeated measures ANOVA was conducted for both cortisol and testosterone. For cortisol, a significant main effect for load (P = .007) revealed higher cortisol values were evident for the 16kg load. For testosterone, a significant main effect for load (P = .05) was evident showing higher testosterone values for the 16kg load. There was also a significant main effect for time (P = .001) where testosterone values were all significantly higher post exercise compared to pre. There were no time X load interactions for cortisol or testosterone (P>.05). For HR and RPE, a series of 2(16kg vs 8kg load) X 12(time) way repeated measures ANOVA were conducted. Higher HR was seen in 16kg load (P = .004) with HR significantly increasing with repetition, irrespective of load (P = .001). A significant load X time interaction (P = .002) for RPE indicated that RPE increased with repetition more markedly for the 16kg load compared to the 8kg load.
Discussion
The KB swing exercise produces an acute increase in hormones involved in muscle adaptation but that KB load influences this response even when total work completed is the same. Additionally, the aerobic demand of the KB swing is greater with higher load, when total work is held constant. The KB swing exercise might therefore augment outcomes for strength and conditioning where increased aerobic capacity is desired.
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FORCES AND POSITIONS IN SUSPENSION LUNGE EXERCISE

AGUILERA-CASTELLS, J.1, BUSCÀ, B.1, FORT-VANMEERHAEGHE, A.1,2, SOLANA-TRAMUNT, M.1, MORALES, J.1
1: FPCEE BLANQUERNA RAMON LLULL UNIVERSITY (BARCELONA, SPAIN), 2: EUSES GIRONA UNIVERSITY (GIRONA, SPAIN)

Introduction
Lunge is one of the most used exercise in strength and conditioning programs (McCurdy et al., 2004). Variations of lunge techniques, like position, overload and unstable surface or the use of suspension devices, seems to modify the muscle activation and force production (Dawes & Melrose, 2015; Saeterbakken & Fimland, 2013). For this reason, the aim of the study was to compare the forces exerted on a suspension strap for different positions and paces in lunge exercise.
Methods
10 healthy male young subjects (age = 14.80±1.09 y, height = 1.72±0.07 m, weight = 60.40±8.62 kg) performed lunge exercises under four different positions and three different paces using a TRX Suspension Trainer (TRX®, San Francisco, CA, USA). Peak forces (N) were assessed using a S-Type Load Cell (model CZL301C; Phidgets Inc., Alberta, CAN) displayed on the suspension device. A repeated measures ANOVA was used to determine the position and pace effects. Relative force increases (%) were also calculated.
Results
A significant main effect was found for frequency [$F(1.22, 11.04) = 8.476$, $p<0.05$]. Pairwise comparisons showed significant differences ($p < 0.05$) between frequency 1 and 3 in position 2 (11,2% higher), and between frequency 1 and 2 in position 4 (11% higher). Moreover, force increments ranged from 4.8% to 11.1% and from 7.3% to 13.6% when comparing frequency 1 with 2 and 3, respectively.
Discussion
According to Jakobsen et al. (2013), peak force production increases in higher paces. However, no significant increases were found between the different positions in contrast to Gulmez (2016) who reported significant variations of body mass resistance in other suspen-

sion exercise like push-up. The importance of the frontal leg for lunge execution minimize the forces exerted on the suspension straps but this data could be useful for quantifying the load that the exercise execution represents.

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Contact
joanac1@blanquerna.url.edu

PEAK POWER OUTPUTS DURING TRUNK ROTATIONS OCCUR AT LIGHT TO MODERATE WEIGHTS, DEPENDING ON SPORTS SPECIALIZATION OF ATHLETES

ZEMKOVÁ, E.1,2, JELEŇ, M.2, POÓR, O.1, HAMAR, D.1

1: FACULTY OF PHYSICAL EDUCATION AND SPORT, COMENIUS UNIVERSITY IN BRATISLAVA, 2: FACULTY OF ELECTRICAL ENGINEERING AND INFORMATION TECHNOLOGY, SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA (SLOVAKIA)

Introduction
It is known that maximum force production occurs when the speed of movement is very low. As the speed of movement increases, force decreases and at very high speeds force production is very low. Consequently, peak power occurs at intermediate velocities when lifting moderate weights, i.e. 50-60% 1RM (Hamar 2008). However, this has been proven in typical resistance exercises such as bench presses or squats, yet a little is known about the power production during the upper/lower body rotation movements. We were interested, therefore, in determining the weight and/or velocity at which peak values of power during trunk rotations occur and to what extent it depends on sports specialization of athletes.
Methods
Seventy six athletes of various sports (age 22.7±4.1 y, height 179.6±8.3 cm, body mass 87.1±13.3 kg) completed a set of trials of trunk rotations with stepwise increasing weights (from 5.5 kg up to 1RM). From a standing position with feet shoulder width apart while holding a bar weight on the shoulders, they performed two trunk rotations with a maximal effort in the acceleration phase to each direction, in random order (e.g. rotated to the right, then reversed direction and rotated to the left and vice versa). Throughout the movement, basic biomechanical parameters were monitored using the FiTRO Torso Premium system.
Results
Mean power during trunk rotations steeply increased from lower weights, reached a maximum and then toward higher weights, slowly decreased again. Specifically, there were significant differences in power achieved between weights of 5.5 and 10.5 kg ($p=0.009$), 15.5 and 20 kg ($p=0.021$), and 20 and 25 kg ($p=0.044$), whereas its values did not differ significantly when higher weights were used (≥30 kg, $p>0.05$). Peak values of power were observed at 10.5 kg (245.3±68.4 W) in 23 athletes, at 15.5 kg (251.7±78.0 W) in 34 athletes, at 20 kg (264.8±81.3 W) in 15 athletes, and at 25 kg (322.0±60.8 W) only in 4 athletes.
Discussion
Peak power during trunk rotations occurs at loads from 30 to 45% of 1RM. This variation in power production at light to moderate weights may be ascribed to the specificity of training adaptation. Hence, the exercise that closely replicates the trunk rotation should be used to assess the sport-specific rotational power.

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Contact
erika.zemkova@uniba.sk

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ASSESSMENT OF LOWER BODY AND ABDOMINAL STRENGTH IN PROFESSIONAL SOCCER PLAYERS

MICHAELIDES, M.

UCLAN CYPRUS

Introduction
Soccer is considered a physical sport and it requires a high level of physical strength to perform at high standards. The knee joint has been evaluated regularly in soccer players for strength and insufficiencies but limited or no evidence exist on abdominal strength. The purpose of this study was for the first time to evaluate the abdominal strength in professional football players and compare the findings to their lower body strength.
Methods
An observational design was used to examine the abdominal and lower body strength using two functional performance tests (a lower body isokinetic and an isometric abdominal test respectively). One hundred and thirty-two professional male football players from Cyprus divisions 1, and 2 participated in this study. Testing included 3 and 25 maximal concentric flexion and extension repetitions at angle speeds of 60°/sec and 300°/sec respectively. On a separate occasion participants completed two trials on the ABTEST Gen. 3 system for evaluation of abdominal strength.
Results
The abdominal strength had low to moderate significant correlations ($p<0.05$) with quadriceps and hamstrings strength, at both isokinetic speeds of 3000/sec and 600/sec. Coefficient of determinations (R2) demonstrated that the isokinetic parameters variability accounted only for by 14-16% of the variability of the abdominal strength.
Discussion
The abdominal strength appears to be high in professional soccer players but is non-dependent on playing standard and/or playing position. The results of this study demonstrated that abdominal strength and the knee joint strength should be evaluated separately.

THE EFFECTS OF HIGH-INTENSITY TREADMILL RUNNING PROTOCOL ON SPEED PERFORMANCE IN HURDLE ATHLETES

YI-CHI, W.
UNIVERSITY OF TAIPEI

Introduction
The hurdle is a sport with high endurance, strength and technicality. The relationship between stride length and steps frequency is the key to determine the maximum speed, to investigate the effects of speed facilitation training in hurdles players for sports performance and speed, increasing frequency and increase stride length in order to make the speed increase.
Methods
12 hurdle athletes (21.1 ± 1.1) were recruited to this study. 8 weeks high-intensity treadmill running training intensity started from 90% of each participant's maximum speed and gradually incremented 2% every two weeks until the 8th week., the training schedule was 4 times per week. The training program was 10 seconds for workout and 3 minutes for rest, repeated 8 times. Health-related fitness, skill-related fitness and hurdle technical were examined before and after the exercise interventions.
Results
There were significant increase between pre- and post-test in T-agility test (11.69 ± 0.77 vs. 11.05 ± 0.75, p <.05), counter-movement jump (36.12 ± 5.5 vs. 40.4 ± 7.8, p <.05), anaerobic capacity (9.24 ± 1.21 vs. 9.55 ± 1.12, p <.05), on standing long jump (2.34 ± 0.3 vs. 2.41 ± 0.3, p <.05), 30-meter sprint(4.63 ± 0.36 vs. 4.44 ± 0.37, p <.05) and standing triple jump (7.18 ± 1.05 vs. 7.36 ± 0.9, p <.059).
Discussion
After 8 weeks high-intensity treadmill running training, we found out no significant for the hurdle technique analysis, but there were lower speed, limb's muscular power and agility in hurdle players were increased. We suggest the training program may not only has hurdle technique but also combined with speed facilitation and speed endurance training in the future.
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RELATIONSHIP BETWEEN AFFECTIVE STATES AND PHYSIOLOGICAL STRESS AFTER MODERATE AND EXHAUSITVE EXERCISE

SUDO, M., KOMIYAMA, T., NAGAMATSU, T., HIGAKI, Y., ANDO, S.
PHYSICAL FITNESS RESEARCH INSTITUTE

Introduction
It has been suggested that exercise is beneficial to mental health through stress reduction and antidepressant/anxiolytic properties. In contrast, exercise can be a stressor and alters affective state depending on its intensity. Nevertheless, it is less clear how physiological stress induced by acute exercise alters affective state. The purpose of this study was to examine how affective states are altered after moderate and exhaustive exercise, and to identify relationship between affective states and physiological stress biomarkers.
Methods
Forty-two participants were assigned into control (Control, N =12), exhaustive exercise (Exhaustive, N = 18), and exercise intensity corresponding to 40% peak oxygen uptake (Moderate, N =12) groups. The participants completed blood sampling and the Mood Check List-short form 2 (MCL-S.2) that evaluates affective states (Pleasure, Relaxation, and Anxiety) (Hashimoto and Murakami, 2011). We analyzed blood adrenaline, noradrenaline, and cortisol concentrations. Spearman's correlation coefficients was used to measure the strength of association between alterations in affective states and physiological variables.
Results
Relaxation was reduced after exercise in the Exhaustive group (pre: 4.0 ± 2.7 vs. post: 0.3 ± 4.0, P = 0.003), while it was not altered in the Control and Moderate group. Pleasure and Anxiety were not altered in all groups. Adrenaline, noradrenaline, cortisol increased after exercise in the Exhaustive (adrenaline, pre: 51.5 ± 26.7, post: 176 ± 232 pg/mL noradrenaline, pre: 457 ± 143, post: 1364 ± 512 pg/mL, cortisol, pre: 15.6 ± 4.78, post: 19.9 ± 5.30 μg/mL) and Moderate (adrenaline, pre: 38.8 ± 15.1, post: 71.5 ± 22.4, noradrenaline, pre: 340 ± 101, post: 476 ± 148, cortisol, pre: 16.7 ± 5.51, post: 14.0 ± 4.59) groups (All Ps < 0.05). In the Exhaustive group, delta relaxation was negatively correlated with delta adrenaline (r= -0.50, P = 0.03) and delta cortisol (r = -0.49, P = 0.04). However, we observed no significant correlations between affective states and physiological stress biomarkers in the Control and Moderate group.
Discussion
In the present study, moderate exercise did not influence affective states. This suggests that the exercise intensity was not sufficient enough to induce affective states. Relaxation significantly decreased after exhaustive exercise. Furthermore, alterations in relaxation were negatively correlated with alterations in adrenaline and cortisol. These results indicate that relaxation decreased for individuals with greater increases in physiological stress biomarkers. Hence, the present results suggest that high physiological stress have the detrimental effects on affective states. It was suggested that the questionnaire used in this study may be a useful predictor of affective state under stressful situations.
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Contact
msudo@tai-ken.jp

RELATIONSHIPS BETWEEN VARIOUS AEROBIC FACTORS DURING AND AFTER MAXIMAL EXERCISE IN ELITE ATHLETES

YAMAGISHI, T.1, SAITO, A.1, MAEO, S.1, KAWAKAMI, Y.1
1:WASEDA UNIVERSITY

Introduction

High peak oxygen uptake (VO2peak) is prerequisite for success in the majority of sporting events since VO2peak sets the upper limit of an athlete's aerobic capacity. However, sub-maximal factors (e.g. lactate threshold) also play a role in endurance performance, and enhanced recovery following intense exercise likely improves performance where athletes are required to perform repetitive high-intensity activities with limited recovery periods (e.g. basketball, boxing). Nevertheless, the relationships between these factors have not been fully understood, especially in elite athletes. Therefore, this study aimed to examine relationships between various aerobic parameters in elite athletes.
Methods
39 Japanese (males: 20, females: 19) elite junior and senior athletes (14 to 34 years, VO2peak: 37.2 to 70.7 ml·kg-1·min-1) competing in various kinds of sporting events (e.g. swimming, basketball, badminton, sport climbing) participated in this study. All athletes performed a cycling ramp test protocol to exhaustion for the determination of VO2peak. In addition, ventilatory threshold (VT) was determined to estimate lactate threshold. The VO2 recovery capacity was assessed by the time required to reach 50% of VO2peak (T50) after the exhaustion, whereas the heart rate recovery (HRR) was determined by subtracting heart rate at the first minute of recovery from maximal heart rate (Shetler et al., 2001). Relationships between the variables were assessed with Pearson's correlation coefficients with the significant level being set at $p < 0.05$.
Results
A significant correlation was seen between VO2peak and VO2 at VT ($r = 0.72$), while there was no relationship between VO2peak and relative intensity (%VO2peak) at VT ($r = 0.08$). There were inverse correlations between VO2peak and T50 ($r = -0.59$) and VO2 at VT and T50 ($r = -0.62$), whereas no correlation was found between VO2peak and HRR ($r = -0.19$) or T50 and HRR ($r = 0.03$).
Discussion
This study shows that individual differences in VO2peak relate to the rate of post-exercise VO2 recovery, likely reflecting enhanced oxidative metabolism during and after an intense exercise in athletes with high VO2peak (Tomlin and Wenger, 2001). In contrast, the heart rate recovery rate was not related to VO2peak or VT, suggesting another factor of neural origin (e.g. sympathetic withdrawal) plays a major role in HRR. Moreover, this study did not show any relationship between VO2peak and VT when expressed as relative intensity (i.e. %VO2peak at VT), suggesting that high VO2peak is not necessarily associated with improved substrate utilisation (e.g. improved lactate utilisation).
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Contact
t.yamagishi@aoni.waseda.jp

GLOMERULAR FILTRATION RATE AND MILITARY PHYSICAL ACTIVITY DURING "2012 BRAZILIAN COMANDOS COURSE"

ROLIM FILHO, N.1,2,3, DOMINGUES, C.1, ANNUNZIATO, J.1, BOVOLINI, J.A.3, CARDOSO, D.3, DUARTE, J.3

1.EB(BRASIL) 2. CNPQ(BRASIL) 3.FADEUP(PORTUGAL)

Introduction
Strenuous physical exertion can cause muscle damage that is a dysfunction in the cell membrane, which allows the migration of the intracellular content into the extracellular environment and into the systemic circulation. Muscle damage, renal system and kidney function relation can be identified from quantification of specific serum levels of muscle enzymes and through the Glomerular Filtration Rate.
Methods
Biomarkers from 19 subjects of "2012 Brazilian Comandos Course" were collected, one time per week, during 14 weeks. Serum creatinine, uric acid and urea levels were analyzed by Vitros250 and kits of dry-chemistry method. The estimated Glomerular Filtration Rate (eGFR) was calculated by CKD-EPI, expressed as ml/min/1.73m2, using ethnic group, age, sex and serum creatinine information. The skeletal muscle mass evaluation was carried out with bioelectrical impedance analysis-InBody720. Data analyses in SPSS version 22, relation of measurements to other baseline characteristics was assessed using Nonparametric tests (Friedman) and post hoc (Wilcoxon signed-rank tests).
Results
The significant increase were found in the trends of creatinine which rise from baseline (0.92+0.08 to 1.56+0.28 mg/dL), Urea (33.7+6.4 to 74.95+14.7 mg.dL-1), eGFR rates decreased from baseline 128.18+15.07 to 77.78+20.98, all this set during 5th week. Skeletal muscle mass (38.5+4.5 Kg) increased at 10th week with 40.6+ 4.7 Kg. Acid uric decrease at 11th week (10.27+1.77 to 4.26+0.45 mg.dL-1). The highest mean ranks were demonstrated at 5th week (creatinine=15.85; urea=15.77; uric acid=16) except by the skeletal muscle mass (14.25) at 10th and eGFR (14.88) at 11th. Wilcoxon showed at the 5th week has a significant impact on eGFR findings ($Z=-3.823$, $p=0.00$).
Discussion
Military personnel are compromising renal function due to the execution of strenuous physical exercise performed in adverse weather conditions, to quantify the intensity and quality of the military task will be decisive. The current modern combat is characterized by the combination of intense physical exertion, dehydration, lack of food and it can significantly influence the physiological responses consequently muscle damage and glomerular filtration. Indeed, eGFR and skeletal muscle mass decreased during the 5th week (Leadership Development Exercise). Evidence suggests that eGFR is the best index of renal function (Wasung M.E. et al, 2015).
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CHANGES IN HEART RATE OF A JUMPER IN LONG JUMP ROPE

YOSHIDA, N.1, WADA, T.1, TAMARI, Y.1, HAMADA, H.1, YAMAGUCHI, H.2, ONODERA, S.3

1GRADUATE SCHOOL, KAWASAKI UNIVERSITY OF MEDICAL WELFARE, 2KIBI INTERNATIONAL UNIVERSITY, 3KAWASAKI UNIVERSITY OF MEDICAL WELFARE

Introduction
Elementary schools in Japan undertake physical education classes. However, there is no report on the physiological response of the jumpers in the long jump rope exercise. The purpose of this study was to clarify the effect on the heart rate of a jumper in the long jump rope exercise.

Methods
Seven healthy Japanese males volunteered to participate in this study. Their age, heights, body weights, and BMI were 22 ± 2 years, 172.9 ± 5.9 cm, 68.9 ± 8.7 kg, and 23.1 ± 2.9, respectively (mean ± SD). All subjects signed informed consent forms prior to participation in this study. Measurement conditions were set for the rope condition and the rhythm condition. The rotational speed of the rope was 90 rpm. The experimental protocol called for sitting on a chair to rest for five minutes followed by three minutes of exercise and five minutes of again sitting on a chair to rest for recovery. The selected exercise was to jump for three minutes under both the aforementioned conditions. The long jump rope used was certified by the NRAJ (National Recreation Association of Japan; length of rope: 10 m). Measurement indices were heart rate, rating of perceived exertion, and blood pressure (systolic blood pressure: SBP, diastolic blood pressure: DBP).
Results and discussion
The heart rate of a jumper under the rope condition was significantly higher than that under the rhythm condition at one, two, and three minutes during the exercise and two, three, four, and five minutes after the exercise (each: $p < 0.05$). The rating of perceived exertion of a jumper under the rope condition was significantly higher than that under the rhythm condition at two and three minutes during the exercise and at one, two, three, and five minutes after the exercise (each: $p < 0.05$). The DBP of a jumper under the rope condition was significantly lower than that under the rhythm condition at three, four, and five after the exercise (each: $p < 0.05$). Based on these results, the workload of the jumper was significantly higher during the jumping under the rope; therefore, the jump is a form of anaerobic exercise. These results suggest that the reason for the higher workload was the existence of the rope. The workload of a jumper was significantly higher during jumping under the rope.

Mini-Orals

MO-PM29 Hypoxia and blood flow restriction 1

THE CONTROL OF THE NORMOBARIC HYPOXIA INTENSITY IN OLDER AND YOUNG PEOPLE

TÖRPEL, A., SCHEGA, L.
OTTO VON GUERICKE UNIVERSITY MAGDEBURG

Introduction
Intermittent normobaric hypoxia (IH) does not only reach increasing attention with respect to the improvement of physical performance in athletes, but is also considered a new therapeutic modality to be a preventive treatment strategy in clinical settings (Verges et al., 2015). Therefore, the effectiveness of an applied hypoxic stimulus to evoke adaptions depends on the degree, duration and/or regularity of an exposure. We aimed to investigate the dose-response relationship regarding the control of the degree of hypoxia in older vs. young people.
Methods
35 older (60 to 75 years) as well as 29 young people (18 to 35 years) were recruited. The participants of each cohort were randomly assigned to hypoxia groups (HG-old; HG-young) or control groups (CG-old; CG-young). The CGs received ambient air (fractional inspired concentration of oxygen: FiO2=20.9%) and the HGs received normobaric hypoxia in a rest position over three hours. In the HGs the FiO2 were individually adjusted to 80% of oxygen saturation of the blood (SpO2). Group effects were calculated using a one-way ANOVA ($\alpha<5\%$).
Results
We adjusted the FiO2 significantly (p=.014) lower in the HG-young (10.6±1.1 %) as compared to the HG-old (11.7±1.6%) to reach the predefined SpO2 (HG-young: 80.1±1.4%; HG-old: 80.8±1.6%).
Discussion
In most of the previous studies IH has been supplemented by a predefined FiO2. We assessed significant differences between older and young people with respect to the regulation of normobaric hypoxia to reach a certain level of systemic hypoxia. These differences could be explained by age-related changes on the genetic and morphological levels. Rivard et al. (2000) detected a defect of the hypoxia-inducible factor (HIF) action in old age which is needed by oxygen sensors (chemoreceptors) to induce acute reactions of the ventilation and cardiovascular system (Prabhakar, 2013). Moreover, degenerative changes of the lung-morphology could lead to a decreased supply of oxygen under hypoxic conditions (Janssens et al., 1999). The deterioration of both may lead to a decrease in the ability to compensate a hypoxia stimulus which leads to varying values of systemic hypoxia in the age. This phenomenon causes a different amount of adaption. We recommend that the degree of IH interventions should be regulated individually to a predefined SpO2.
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Contact
alexander.toerpel@ovgu.de

EFFECTS OF CYCLING EXERCISE AND AQUATIC EXERCISE IN HYPOBARIC HYPOXIA ON VASCULAR ADAPTATIONS AND GLUCOSE TOLERANCE

OGITA, F.1, YOTANI, K.1, GOTO, K.2, KATAYAMA, K.3, TAMAKI, H.4
1:NATIONAL INSTITUTE OF FITNESS AND SPORTS (KANOYA, JAPAN), 2 RITSUMEIKAN UNIVERSITY (KUSATSU, JAPAN), 3 NAGOYA UNIVERSITY (NAGOYA, JAPAN), 4 NIIGATA UNIVERSITY OF HEALTH AND WELFARE (NIIGATA, JAPAN)

Introduction
Recently, we have reported that "aquatic exercise" in hypobaric hypoxia could improve more effectively cardiovascular and metabolic risk markers, such as arterial stiffness, blood pressure, body composition, serum lipid level, glucose tolerance, and so on, when compared with the those in normobaric normoxia (Ogita 2011, Ogita 2014). However, it has not been clarified whether the comparable improvements can be found in the other type of exercise. Therefore, the present study aimed to examine the effects of cycling exercise and aquatic exercise in hypobaric hypoxia on vascular adaptations and glucose tolerance.

Methods
Thirty-eight male adults (24±3 yrs) were assigned into 4 groups. They had cycling (CE) or aquatic exercise (AE) at the intensity of around 50% of VO2max for 30 minutes/training session in normobaric normoxia (N) or hypobaric hypoxia (H) corresponding to 2500m above sea level for 5 consecutive days. The subjects in H-CE and H-AE were exposed to the condition for 2 hours/session. Before and after the training, brachial-ankle pulse wave velocity (baPWV) and flow mediated vasodilation (FMD) were determined to assess changes in arterial stiffness and vasculature endothelial function, respectively. FMD was calculated by changes in diameter of the popliteal artery between rest and during reactive hyperemia. Also, 3-h oral glucose tolerance test (OGTT) was conducted.
Results
After the 5 consecutive days training, no significant changes were observed in all variables for N-AE, N-CE. On the other hand, a significant decrease in baPWV and an increase in FMD (%FMD) were found in H-AE (both $P < 0.01$), but not in H-CE. Area under the curve (AUC) of blood glucose concentrations during OGTT did not change significantly, however, AUC of insulin concentrations during OGTT significantly decreased in both H-CE and H-AE.
Discussion
These findings suggest that glucose tolerance could be improved by any type of exercise in hypobaric hypoxia but that vascular adaptations such as improvements of arterial stiffness and vascular endothelial function might be influenced by the exercise type.
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Contact
ogita@nifs-k.ac.jp

OLFACTORY IDENTIFICATION CAPACITY IS NOT AFFECTED DURING HIGH ALTITUDE CLIMBING

FRON, K., SCHULZ, S., FISCH, M., KRUSCHE, T., PLATEN, P.
FACULTY OF SPORT SCIENCE, RUHR-UNIVERSITY BOCHUM

Introduction
Nutrition restriction may negatively affect safety and performance in sports. Mountaineering at high altitude requires sufficient energy intake to guarantee physical performance and safe acting under such conditions. But previous studies could show that appetite and hunger were inhibited in hypobaric hypoxia [1]. Therefore, the gustatory and the olfactory sense determine the quality of taste. The purpose of the study was to investigate the olfactory identification capacity (OIC) at moderate and high altitude.
Methods
OIC of 17 healthy young moderate trained subjects (m=11; w=6, age=25.0±8.1 yrs, BMI=22.8±1.5 kg/m2) was measured 4 days before (d-4:156m) and during (d2:890m, d3:2750m, d5:3950m) a 7-day ascent to the top of Mt. Kilimanjaro (5895m, Tanzania). OIC was tested blinded and randomized using 16 different fragrances of natural and industrial everyday smells for identification in 20s intervals (Sniffin˝Sticks) [2]. Each stick was swung four times in a distance of 3cm to the subject's nose before choosing one of four possible choices. Throughout the test the examiner was wearing cotton gloves to prevent disturbing fragrances near the application. The error rate (percentage number of faults) of OIC is presented as median (M) and the 1. and 3. quartile.
Results
OIC remained unchanged at all altitude conditions compared to d-4 (d-4: M=19.0, P25=12.0, P75=31.0, d2: M=19.0, P25=12.0, P75=22.0, d3: M=19.0, P25=15.5, P75=25.0, d5: M=19.0, P25=19.0, P75=23.5 % faults, $p<.05$). The fragrances pineapple (47.8% faults), apple (73.1% faults), and turpentine (94.0% faults) showed the highest error rates at all test times. None of the subjects reported on disorders in eating behavior.
Discussion
Our data show no effect of moderate and high altitude on OIC in healthy young people. However, our results are contradictory to recent data suggesting an impairment on OIC at 2700m [3] and 3937m [4]. In these studies changes in OIC were found during acute hypobaric hypoxia in contrast to our study with a 5-day-acclimatization. In this context, we assume that good acclimatization might prevent impairments of olfactory perception and/or decreased appetite at altitude does not result because of changes in OIC. On the other hand, one limitation of the study was that we cannot rule out a kind of learning/recognition effect during testing OIC. Therefore, we recommend further studies to investigate possible effects of altitude condition on olfactory perception.
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Contact
Kevin.Fron@rub.de

RESISTANCE TRAINING WITH BLOOD FLOW RESTRICTION PROMOTES INCREASE MUSCLE MASS AND STRENGTH IN PEOPLE LIVING WITH HIV/AIDS

ALVES, T.C.1, ABDALLA, P.P.2, DOS SANTOS, A.P.1, ROSSINI VENTURINI, A.C.2, MACHADO, D.R.L.1,2
UNIVERSITY OF SAO PAULO

Introduction
People living with HIV/AIDS (PLHA) are prone to morbidities associated with premature aging and frailty. Resistance training with blood flow restriction (RTFR – 20-50% 1RM) enables to include people with functional weakness (FW) in weight training programs. Thus, the goal of the study was to verify the impact of RTFR and traditional resistance training (TRT) on muscle mass (MM), and strength (S) in PLHA and control group (CG).
Methods
A sample of 21 patients was divided into three groups: RTFR (n=7), TRT (n=6), and CG (n=8). The maximum repetition test determined the loads for the RTFR (30% 1RM) and TRT (80% 1RM) groups, undergoing a 12-week-training period with three weekly sessions of elbow and knee flexion/extension. The body composition was determined by DXA at the pre and post-training period. ANOVA two-way, Wilcoxon signal test and effect size of intervention ($\eta 2$) were used for data analysis ($\alpha=0.05$).

Results
There was a significant increase in total MM: RTFR (Z=-2.2, p=0.028, η2=0.69); TRT (Z=-2.0, p=0.046, η2=0.68), and relative (MM/weight2): RTFR (F=11.6, p=0.014, η2=0.66); TRT (F=10.4, p=0.023, η2=0.66). The significant increase in S varied according to the type of training and muscle groups, RTFR: triceps (Z=-2.4, p=0.018, η2=0.75), biceps (F=12.2, p=0.013, η2=0.67), hamstrings (F=10.5, p=0.018, η2=0.64) and quadriceps (Z=-2.4, p=0.018, η2=0.87); TRT: triceps (Z=-2.2; p=0.028, η2=0.89), biceps (F=19.9, p=0.007, η2=0.80), hamstrings (F=7.5, p=0.041, η2=0.60), and quadriceps (Z=-2.2, p=0.028, η2=0.77).
Discussion
Like illness that affect muscle function such as cachexia syndrome, PLHA present reduced MM, S and functional capacity (ERLANDSON et al., 2013). TRT is efficient as a complementary therapy for PLHA, increasing MM and S (YARASHESKI et al., 2001). However, there are patients in marked FW unable to exercise with intensity higher than 70% 1RM, so RTFR has been shown to be effective in promoting increase of MM and S in PLHA, similarly to that achieved by TRT, and can be used as an alternative method.
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Contact
thiago_alves@usp.br

THE EFFECT OF ACUTE OCCLUSION BURDEN ON MUSCLE-SPECIFIC MICORNA AND CONTEXTUAL GENE EXPRESSION PROFILE IN THIGH EXTENSOR MUSCLE

TORMA, F., OSVÁTH, P., TARCZA, Z., RADÁK, Z.
UNIVERSITY OF PHYSICAL EDUCATION

Introduction
The approach of our study was to unite the beneficial effects of blood flow restriction (BFR) exercise protocols and high intensity resistance training. Recently the two form of exercise is applied exclusively because high load muscle contraction combined with BFR implies severe risks for pathological muscle damage. The low intensity BFR exercise demonstrated to elevate the paired box 7 protein (PAX-7) positive myonuclei in satellite cells (SC). Our aim was to combine BFR and high intensity resistance training and investigate the transcription profile of the treated muscle in response to plausible myoMIR expression.
Methods
7 young healthy male volunteers participated in our study with no reported medical issues and risk factors. The subjects preformed squat exercise with 7x10 repetitions, 70% of their one-repetition maximum. In our exercise protocol during the resting period of two minutes the right leg was exposed to one minute total occlusion (~180Hgmm, no blood flow detected in the popliteal artery), during the rest period immediately after depressurising the cuff blood flow velocity measurement was conducted. Microbopsy (18Gx100mm) samples were taken from the blood flow restricted and the control vastus laterals muscle with local analgesia after 2 hours of the exercise session. From frozen samples RNA was isolated and cDNA was synthetized for myoMIR and mRNA real time PCR- procedure. The residual sections were saved for SDS-PAGE and western blot analysis.
Results
After normalisation, only the miR206 myoMIR showed significant decrease in response to occlusion (paired t-test: p<0, 05). In case of mRNA, increased gene expression was detected for Akt2, NRF1, VEGF and Ku70 genes (paired t-test: p<0, 05) in the occluded limb. These genes are associated with protein synthesis (Akt2), angiogenesis (VEGF), cellular respiratory processes together with mitochondrial biogenesis (NRF1), and stress induced DNA repair (Ku70). Our most intriguing finding yet is the robust increase in PAX7 mRNA levels (paired t-test: p<0,01).
Discussion
Our study suggests that the proposed satellite cell activation in response to BFR is influenced by the decreased mir206 expression via the permission of PAX7 production. PAX7 is a transcription factor expressed in dividing satellite cells. As a conclusion there is a possibility that miR206 plays a key role in SC-activation, and in BFR induced hypertrophy. Furthermore high resistance training combined with resting state occlusion can be a novel useful tool for enhancing athletic performance.

Mini-Orals

MO-PM18 Ageing: Balance and stability

VALIDITY AND RELIABILITY OF A NOVEL INTEGRATIVE MOTOR PERFORMANCE TESTING AND TRAINING COURSE FOR SENIORS: THE "AGILITY CHALLENGE IN THE ELDERLY "

LICHTENSTEIN, E., FAUDE, O., ROTH, R., RÖSSLER, R., ZAHNER, L., HINRICHS, T., DONATH, L.
UNIVERSITY OF BASEL

Introduction
Falls are a leading cause of disability in seniors. Traditional exercise based fall prevention programmes mainly tackled neuromuscular fall risk factors independently (i.e. balance, gait, strength). Functional and integrative training approaches are scarce (Donath et al., 2016). The present study proposes an integrative agility course. We aimed to examine whether the walking-based "Agility Challenge in the Elderly" (ACE) course is a valid and reliable approach to integratively assess neuromuscular and cardiocirculatory capacity in seniors.
Methods
36 healthy seniors (age: 69 ± 3 y; BMI: 25 ± 4 kg/m2; sex: 19 males/17 females; weekly physical activity: 4.7 ± 3.8 h) were tested twice one week apart. All participants completed four trials of the ACE-course on both testing days. The 6-minute walk test (6MWT) assessed cardiovascular capacity. On a separate day fall risk factors were assessed including static, dynamic and perturbed standing balance tasks, rate of force development (RFD) of the lower extremities and trunk as well as spatio-temporal gait analysis under single- and multi-

task conditions. The ACE-course consists of three sections focusing on different agility aspects (1. stop-and-go in order to accelerate and decelerate; 2. cutting maneuvers for directional changes; 3. spatial orientation).
Results
Men completed the course in 44 ± 6 s and women in 52 ± 4 s. Split times for the stop-and-go, cutting maneuvers and spatial orientation were 6.8 ± 1.0, 13.8 ± 2.3 and 26.3 ± 3.6 sec, respectively. Variance in the overall and split times was explained by 6MWT time (ΔR2=0.17-0.27; p<0.001) and habitual gait speed (ΔR2=0.14-0.25; p<0.001). Other variables only explained a minor part of the variance of the overall and split times (ΔR2<0.07; p>0.05). Very good between- and within day reliability indices were observed for total course and split times: The ICC and CV values for the between day comparison achieved 0.93 [0.89-0.96] and 4.0 % [3.3-5.0], respectively. They ranged between 0.84 (5.7 %) and 0.94 (4.1 %) for split times.
Discussion
The ACE's results reflect cardiocirculatory and potentially neuromuscular capacity. Cardiocirculatory fitness and habitual gait speed contribute to all sections. In this pilot study other potentially explanatory variables only explained a small fraction of the ACE course performance, which is unsurprising considering the complexity of the course. Yet, this functional training and testing approaches may better reflect motor requirement during movements of daily live and fall threating situations. The test appears to be sufficiently reliable.
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MUSCLE QUALITY IN FRAIL ELDERLY INDIVIDUALS DETERMINED BY COMPUTED TOMOGRAPHY

BREIT, M.1,2, AAS, S.N.1, ROSSI, A.P.3, CAPELLI, C.1, SEYNNES, O.R.1, RAASTAD, T.1
NORWEGIAN SCHOOL OF SPORT SCIENCES

Introduction
Fat infiltration within the muscle of the thigh, or intermuscular adipose tissue (IMAT), has been associated with impaired skeletal muscle function (1). Combined with muscle atrophy these changes reduce muscle strength and quality, and in consequence may lead to loss of physical function (2). The explanation for the loss of muscle quality (MQ) with aging is multifactorial with fat infiltration as one contributing factor. As a non-invasive method, computed tomography (CT) provides rapid, accurate information on muscle cross-sectional area (CSA) and enables the measure of fat infiltration between and within the lean tissue in the region of interest (3). The aim of this study was to investigate relations between muscle size and density measured with CT and force-generating capacity.
Methods
This study was conducted on 18 elderly females (7) and males (11) (aged 85.8 ± 8.6 years, BMI 24.4 ± 3.5 kg/m2) recruited from nursing homes and elderly care facilities. Maximal isometric quadriceps strength (MVC) was assessed during knee extension (knee joint angle at 70°). Computed tomography (CT) scans were taken at the mid-thigh, and analysed with ImageJ. Measured in Hounsfield units, IMAT was determined alongside muscle density which was divided into high-density lean tissue (NDM) and low-density lean tissue (LDM) areas based on its attenuation characteristics.
Results
Preliminary data indicated an average IMAT content of 2.4% for the knee extensors, ranging from 0.4% to 6.9%. A strong correlation was found between MVC and m. quadriceps CSA including IMAT ($r = 59$, $P < 0.01$). Excluding IMAT from the quadriceps CSA did not alter the correlation substantially ($r = 0.60$, $p < 0.01$). However, when correlating MVC to NDM only, the correlation was slightly increased ($r = 0.64$, $P < 0.01$). In comparison a negative, but non-significant correlation was observed between MVC and LDM ($r = -0.17$) and MVC and IMAT ($r= -0.25$).
Discussion
The findings display that in frail elderly individuals, muscle density as defined with CT scans is related to force generating capacity. The segmentation of NDM and LDM illustrates a greater strength decline in fat infiltrated lean tissue. This indicates that besides muscle volume, MQ is an important factor in maintaining strength and overall functional capacity at higher age.
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Contact
b.markus@hotmail.com

THE EFFECTS OF FALL HISTORY ON KINEMATIC SYNERGY DURING WALKING

YAMAGATA, M., TATEUCHI, H., SHIMIZU, I., ICHIHASHI, N
KYOTO UNIVERSITY

Introduction
To prevent falls, control of the swing foot during walking is crucial. Recently, some studies demonstrated that the coordinated movement of lower limbs by kinematic synergy is important for stable walking. However, no study has been carried out to reveal the relationship between falls and kinematic synergy, and it is unclear whether fall history alters synergy. Thus, the purpose of this study was to test the effects of fall history on kinematic synergy using uncontrolled manifold (UCM) analysis.
Methods
A total of 27 community-dwelling older adults participated in this study. Fall history was obtained by self-report of questionnaires and the subjects were divided into two groups: older adults without fall history (non-fallers, n = 15); and older adults who experienced at least one fall in the 12 months prior to the measurements (fallers, n = 12). Subjects walked a 6-m pathway at their own comfortable speed, and the kinematics data were recorded with infrared cameras to identify the center of the joints in the frontal plane. UCM analysis (Scholz et al., 1999) was performed to assess how variability of segmental configurations in the frontal plane affects the frontal trajectory of the swing foot. Independent t-tests were conducted to compare variability of segment configurations and synergy between two groups, and the results were used to quantify whether fall history alters the amount of kinematic synergy. The alpha level was set at 0.05.
Results
Across groups, the swing foot was stabilized by kinematic synergy, while fallers increased the variability of segmental configurations as a compensatory strategy to ensure kinematic synergy. Also, the synergy in fallers was significantly greater than non-fallers in the early and late swing phase.

Discussion
In early and late swing phase, synergy in fallers was greater than non-fallers with increasing the variability of segmental configurations. Healthy younger adults increase synergy when precision of foot placement is required during walking or when the threat of falling while walking is added (Rosenblatt et al., 2014). Hence, it is possible that fallers in this study focused on accurate placement of the swing foot or felt a threat about walking even when walking on the normal pathway. It is inferred that non-fallers do not require greater synergy to stabilize swing foot in early and late swing phase due to the effective direct control with each segment, while fallers require the coordination and compensatory strategy of multiple segments by greater synergy.
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Contact
yamagata.momoko.82w@st.kyoto-u.ac.jp

POSTURAL STRATEGY ADOPTED DURING PROLONGED UPRIGHT STANDING DIFFERS BETWEEN YOUNG AND OLDER ADULTS

BOOGHS, C., DUCHATEAU, J., BAUDRY, S.
UNIVERSITÉ LIBRE DE BRUXELLES

Introduction
Upright standing requires the activation of the plantar flexor muscles to avoid forward falling (Loram et al. 2004). The extent of muscle activity needed to keep upright standing, that can increase with prolonged standing (Kuorinka et al. 1978) and ageing (Benguya et al. 2004), influences upright standing steadiness (Billot et al. 2010). Up to now, however, no study has compared the postural strategy used by young and older adults during prolonged unperturbed upright standing.
Methods
Eighteen young (22.6 ± 2 yr, 8 women) and twenty older adults (68.3 ± 4 yr, 11 women) maintained an upright standing position on a foam mat positioned over a force platform during 30 min. Subjects were instructed to keep their feet in the same position and to avoid any intentional movement during this period. The mean position (CoPmean) and the path length (CoPpath) of the centre of pressure were computed for 1-min epoch during the first, 10th, 20th and last minute of the 30-min period. The surface electromyogram (EMG) of soleus and tibialis anterior was recorded for the same epochs, and normalized to the EMG measured during a maximal voluntary contraction (MVC). The changes in CoP and EMG parameters during the 30-min period were analysed within each age group.
Results
During the 30-min period, young adults exhibited a progressive backward shift of the CoPmean that was significant at the 20th (0.6 ± 0.9 cm, $p = 0.022$) and 30th min (0.9 ± 1.1 cm, $p<0.001$), whereas no change ($p>0.05$) was observed in older adults. The CoPpath increased progressively and similarly during the 30-min period in young (+401.9 cm) and older (+255 cm) adults to reach statistical threshold in the 30th min ($p<0.001$). The soleus EMG did not change across time for young adults ($p<0.05$) whereas it increased at the 20th (+4.0 ± 4.6% MVC, $p = 0.035$) and 30th min (+5.3 ± 6.3% MVC, $p=0.002$) in older adults. For both groups, no change was observed for the tibialis anterior EMG ($p>0.05$).
Discussion
The results indicate that young adults use of backward shift of the CoP position that likely minimizes the activity of the main anti-gravitational leg muscle (soleus). In contrast, older adults adopt a more secure position relative to the backward balance boundaries even though this strategy induces a progressive increase in soleus activity. Regardless of the strategy adopted, however, balance steadiness decreased progressively over time. Overall, this study suggests different postural strategies in young and older adults during prolonged upright standing.
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BIOMECHANICAL ANALYSIS OF ONE-LEGGED SIT-TO-STAND MOVEMENTS

HOFFMANN, M., STEINGREBE, H., FRANKE, K., WÖHLKEN, K., BÖS, K., STEIN, T.
KARLSRUHE INSTITUTE OF TECHNOLOGY

Introduction
While a one-legged sit-to-stand (STS) movement represents an easy task for young people, it might pose a problem for elderly people, for instance when standing up from a chair, climbing stairs or alighting from a car, due to a reduced knee extensor strength (Hughes et al., 1996). Numerous studies investigated STS movements with both legs and identified influencing factors such as seat height or the trunk flexion shortly before the seat-off (Janssen et al., 2002). The purpose of the present study was to investigate the effect of different seat heights on the knee mechanics while standing up with one leg.
Methods
19 healthy subjects (52±5 y) performed standardized one-legged STS movements from three different seat heights (depending on body size: 42 or 47 cm in low position, 47 or 52 cm in high position, fixed knee angle of 90°) from a stool. A Vicon 3D motion capture system and an AMTI force plate were used to analyze angles, moments and forces at the knee in frontal and sagittal plane. One-way ANOVA was used to determine the effect of the different seat heights ($p<0.05$).
Results
Statistical analyses revealed that the knee angle in the sagittal plane in initial situation was significantly influenced by the seat height (all $p<0.01$). Moreover, no significant differences could be found between the three seat heights regarding the maximum knee moment, but a significant influence by the maximum knee force. The high seat height caused significant lower knee forces than both other seat heights (all $p<0.05$). In the frontal plane of the knee joint, significant differences could be found between the three seat heights regarding the maximum knee moment as well as the maximum knee force. Again, the high seat height caused significant lower knee moments and forces than both other seat heights (all $p<0.05$).
Discussion

The results demonstrate that the seat height has a decisive influence on kinematics and dynamics of the knee joint. While the maximum forces in the sagittal plane during a one-legged STS movement join the ranks of daily life movements such as stair climbing (15% higher) and level walking (25% lower), the maximum knee flexion moment is twice as large as in stair climbing, level walking as well as in STS movements with both legs (Costigan et al., 2002; Sibella et al., 2003). These findings confirm the importance of appropriate adjusted seat heights during daily life of elderly people and provide information to better assess the STS movement frequently used in motor skill tests.

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Contact
marian.hoffmann@kit.edu

REACTIVE POSTURAL CONTROL BY NON-TRIPPED LEG IN RESPONSE TO TRIPPED LEG BEHAVIOR AFTER A TRIP

NAKAJIMA, T., YOSHIOKA, S., FUKASHIRO, S.

THE UNIVERSITY OF TOKYO

Introduction
Tripping during gait often causes postural perturbation which can lead to fall-related injuries. It is important to understand the mechanisms underlying balance recovery after tripping to prevent fall. After tripping, postural control by a non-tripped (NT) leg (Pijnappels et al., 2004) and proper placement of a tripped (T) leg are required for balance recovery. The aim of this study was to investigate how postural control by the T and the NT legs after tripping prepared for the placement of the T leg.
Methods
Ten male participants (age: 25±2 years) repeatedly walked over a platform at their preferred speed and were tripped in 10 of the 30 trials by an obstacle on the platform. During the experiment, the participants wore goggles with the lower half obscured to prevent them from seeing the obstacle. Ground reaction force and kinematic data were recorded by a motion capture system with synchronized force platforms. Based on these data during the phase between the T leg's release of the obstacle and the T leg's heel strike on the ground, kinematic and kinetic data were calculated.
Results
All participants exerted hip flexion torque in the T leg and hip extension torque in the NT leg after the T leg's release of the obstacle. In all trials, the rate of hip flexion torque development in the T leg was higher than that of hip extension torque development in the NT leg after the release of the obstacle. In addition, angular impulse by hip extension torque on trunk in the NT leg was highly correlated with that by hip flexion torque in the T leg ($r = 0.72$, $p < 0.001$).
Discussion
The larger hip flexion torque in the T leg might have partially contributed to forward acceleration of the T leg for the longer step length. From a biomechanical perspective, the enlargement of the base-of-support by increasing step length is reasonable for balance recovery. On the other hand, hip flexion torque can further accelerate trunk forward rotation caused by tripping. It was suggested that recovery from tripping depended on the ability to control trunk movement (Grabiner et al., 1993). The results showed that participants exerted the hip extension torque in the NT leg as a function of the hip flexion torque in the T leg. Therefore, this study indicates that proper landing for balance recovery after tripping can be achieved not only by the hip flexion torque in the T leg to increase the step length, but also by the hip extension torque in the NT leg to control trunk forward rotation in response to the magnitude of the hip flexion torque in the T leg.

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Contact
tkhr134231@gmail.com

AGE-RELATED CHANGES IN REACTIVE MOTOR RESPONSES TO ACHILLES TENDON VIBRATIONS IN AN INHIBITORY STEPPING REACTION TIME TASK

MAGNARD, J.1, BERRUT, G.1,2, CORNU, C.1, DESCHAMPS, T.1

UNIVERSITY OF NANTES

Introduction
This study aimed to investigate the inhibition requirements of planning and executing a choice step initiation task in older adults following experimental perturbation of proprioceptive information using Achilles' tendon vibrations. Based on the relationships between specific inhibitory processes (perceptive inhibition [PI] vs. motor inhibition [MI]; Nassauer and Halperin, 2003) and balance performance under a specific proprioceptive conflict (Redfern et al, 2009), we hypothesized that the PI is specifically involved in the sensory reweighting process necessary for an efficient motor control in older adults when the proprioceptive input is experimentally altered.
Methods
26 young adults (22.5 ± 2.5 years) and 26 older adults (70.1 ± 3.3 years) were screened for their cognitive status (Mini-Mental State Examination > 26). They performed an inhibitory stepping reaction time (RT) task, in which they had to step as quickly as possible in response to visual stimulus that manipulated specific PI or MI, according to two different proprioceptive configurations: with and without application of Achilles tendon vibration (80Hz). Additionally, the postural sway instability was collected in quiet standing trials with or without the application of vibrations.
Results
Stepping RTs were higher in older adults ($p < 0.01$, +30%). Significant increase of RTs was also observed in presence of inhibitory requirement ($p < 0.01$, +16%). Likewise, our analyses of variance revealed that only RTs in young adults were impaired by the vibratory perturbation ($p < 0.05$, +8%). Finally, the analysis of center-of-pressure trajectories showed that older adults were impacted to a lesser extent than young adults by the vibrations during the quiet standing trials.
Discussion
In contrast to our expectations, the altered proprioceptive context did not impact specifically the PI performances in older adults. Thus, no specific involvement of PI in sensorimotor control of elderly can be assumed. Interestingly, contrary to young adults, stepping RTs perfor-

mances of elderly were not affected by the vibratory perturbation. Two interpretations can be assumed: 1) the nature of the perturbation was not enough to be perceived by their age-affected sensory system, 2) the attentional cost associated with this inhibitory stepping RT task is so high in older adults that vibrations did not impact further the attentional processes related to the necessary postural response.
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Mini-Orals

MO-PM22 Injuries in the lower limb

ANTERIOR CRUCIATE LIGAMENT CREEP AFFECTS NEUROMUSCULAR PERFORMANCE IN HEALTHY SOCCER PLAYERS

NUCCIO, S.1, LABANCA, L.1, ROCCHI, J.1,2, MACALUSO, A.1,2, SBRICCOLI, P.1
1:UNIVERSITY OF ROME

Introduction
The non-contact Anterior Cruciate Ligament (ACL) tear is one of the major injuries in soccer. Knee joint laxity has been recognized as one of the most significant risk factor for ACL injury. It was shown that high-demanding exercise resulted in an excessive increase in transitory knee joint laxity, which has been previously associated to ACL creep, a viscoelastic behaviour that develops in response to both static and cyclic load application. Considering the close relationship existing between creep and altered neuromuscular responses affecting functional knee stability (Sbriccoli et al. 2005), a deep analysis of such mechanisms is needed in soccer players, whose knees are repeatedly subjected to high-level loads. Therefore, the aim of this study was to investigate if ACL creep, resulting from cyclic load application, elicited altered neuromuscular responses in a group of healthy soccer players.
Methods
Eight healthy non-professional soccer players (23±3yrs; 70.6±4.6kg; 1.77±0.05m) volunteered for this study. The knee of the dominant limb was subjected to 10 minutes of passive cyclic loading (CYC) at a mild load (200 N) by means of an arthrometer (GeNouRoB, Laval, France). MVC was assessed during knee flexion/extension (MVCflex and MVCext) before and after the CYC. Biceps Femoris (BF) and Vastus Lateralis (VL) EMG activities were recorded throughout all the experimental session. ACL creep was calculated as the difference in percentage between the final and the initial ACL laxity measured during the CYC. EMG amplitude was computed for both BF and VL during the CYC and MVC assessment.
Results
The ACL showed an increase in laxity as demonstrated by the 18.7% creep developed by the participants ($p<0.01$). BF agonist and antagonist EMG activities decreased by 37.7% ($p<0.05$) and 18.2% ($p<0.01$), respectively. BF and VL EMG amplitudes obtained in the last 30s of CYC were respectively 20.2% and 20.3% higher than those obtained during the first 30s ($p<0.05$). No differences were found between pre- and post-CYC MVCext and MVCflex.
Discussion
Healthy soccer players develop creep and altered BF neuromuscular responses, potentially leading to greater knee instability. If these data will be confirmed by future investigations, it will be critical to implement tailored preventive programs. In addition, examining these mechanisms in ACL-injured and/or ACL-reconstructed soccer players, may provide further pivotal evidences which could contribute in strengthening rehabilitation protocols for reducing the risk of re-injury at the time of return to sport.
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Contact
nuccio.stefano@gmail.com

THE FUNCTIONAL CHARACTERISTICS IN FEMALE ATHLETES WITH/WITHOUT FEAR OF RE-INJURY AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

SATOH, M., KAGAYA, Y., MASE, Y.
HACHIOJI SPORTS ORTHOPAEDIC CLINIC

Introduction
Fear of re-injury is one of the most common reasons that athletes do not return to their pre-injury level of sports after anterior cruciate ligament (ACL) reconstruction (Ardern et al., 2011; Gobbi & Franciaco, 2006). However, it is unknown whether fear of re-injury is associated with functional impairment related knee. The purpose of this study was to clarify the functional characteristics in female athletes with/without fear of re-injury at the time of return-to-sports (RTS) after ACL reconstruction.
Methods
This study, cross sectional study design, included 17 female athletes who underwent primary ACL reconstruction using hamstrings autograft. All ACL injuries were non-contact injury mechanism.
Evaluations were done at the individual time of RTS postoperatively. The criteria for returning to sports after ACL reconstruction were permission of the chief physician including completion of full postoperative rehabilitation program, full knee range of motion, a stable knee, and no effusion. Subjective questionnaire consisted of presence or absence of fear of re-injury during the sports activity. Objective evaluations included isokinetic knee muscle strength of extension and flexion and one leg hop (OLH) test toward anterior, lateral, and medial direction.
Isokinetic knee muscle strength and OLH test were analyzed statistically using the Mann-Whitney non-parametric U-test compared the group with fear of re-injury (fear group) and the group without fear of re-injury (no-fear group) ($P<0.05$).
Results
The mean time of RTS was 8.9±0.4 months. The athletes with fear of re-injury were eight (47%). No significant differences ($P>0.05$) were noted between fear group and no-fear group when using the knee muscle strength of extension and flexion, anterior OLH test, and medial OLH test. However, significant difference was observed with the lateral OLH test (fear group
Discussion

This study showed that functional characteristics of ACL reconstructed female athletes with fear of re-injury was less lateral hop ability. Previous kinematic study suggested knee valgus moment occurred at landing phase in lateral hop and jumping phase in medial hop, however did not occur in anterior hop (Ito et al., 2015). The results of our study supported the impression that improving lateral hop ability might decrease fear of re-injury in postoperative rehabilitation.

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Contact
m.satoh@sports-medical.net

THE DEVELOPMENT OF DYNAMIC KNEE ALIGNMENT AFTER BALANCE AND JUMP TRAININGS TO PREVENT ANTERIOR CRUCIATE LIGAMENT INJURY

GOHDA, Y.1, KAGAYA, Y.1,2, TSURUIKE, M.2, TANABE, S.1, OGUSHI, A.3, SUGIHARA, Y.4

1: SHOWA UNIVERSITY (TOKYO & YOKOHAMA, JAPAN), 2: SAN JOSE STATE UNIVERSITY, CA, USA, 3: IZU MEDICAL WELCARE CENTER, 4: SECOMEDIC HOSPITAL

Introduction
Over 70% of anterior cruciate ligament (ACL) injuries in basketball have been suggested to be non-contact, and more specifically occur while landing or sidestep cutting without direct body contact. A number of previous research conducted ACL injury prevention programs, and indicated positive evidence of the effectiveness of training. However, it is difficult to apply such programs to a team during the course of session because most of the prevention programs require time. The aim of this study was to investigate the effect of quick training program selected from the injury prevention program recommended by Woman's Japan Basketball League on the kinematic variables.
Methods
Nine male and six female collegiate basketball players agreed to participate in this study (age: 20.8 ± 1.4 years, height: 166.1 ± 7.3 cm, weight: 58.5 ± 6.6 kg). The subjects performed 3 tasks: 1) both-leg landing, 2) single-leg landing from a 30 cm box, and 3) single-leg squats. This study analyzed knee maximum abduction and flexion angles in each of the tasks by using a three dimensional motion analysis system (Vicon-MX) for baseline (pre-training) and post-training effect. The subjects were trained with the injury prevention program which was composed of five balance and jump trainings 3 times a week for 3 weeks under a supervisor. Paired t-test were used to compare differences in the kinematic variables between pre- and post-training at the alpha level of 5% ($p < 0.05$).
Results
The training program significantly reduced the knee abduction angle in single-leg squats (16.1 ± 7.1° and 13.3 ± 8.1°, pre- and post-training respectively, $p < 0.05$). However no difference in the knee abduction angle was observed for both both-leg and single-leg landing tasks. Also, no difference in knee flexion angles was found between pre- and post-training in all of the tasks.
Discussion
This study conducted the effect of quick training program for ACL injury prevention on the dynamic knee alignment. The results showed that the program reduced the knee maximum abduction angle in single-leg squats. Consequently, the balance and jump trainings are important to stabilize the neutral knee position in single-leg squats. On the other hand, the training program did not modify dynamic knee alignment in both-leg and single-leg landings. Therefore, this study suggests that a difficulty level of activity program be required to improve the dynamic knee alignment for collegiate basketball athletes. Limits of study are related to 3 week training effect. Further studies are recommended, such as a long term of effect on the dynamic knee alignment.

INVESTIGATING PHYSICAL FITNESS AS DETERMINANTS FOR THE ACL INJURY RISK IN FEMALE BASKETBALL PLAYER

KAGAYA, Y.1,2, HORIKAWA, H.1, YUMIGETA, R.1, YAMAUCHI, R.1, IZUMIZAKI, Y.1, INOUE, T.1, HARA, S.1, IRIE, S.1, TSURUIKE, M.2

1:SHOWA UNIVERSITY (YOKOHAMA & FUJIYOSHIDA & TOKYO, JAPAN), 2: SAN JOSE STATE UNIVERSITY (CALIFORNIA, USA)

Introduction
Anterior cruciate ligament (ACL) rupture is one of the major concerns in basketball, and especially female players have been suggested to be 2 to 8 times higher injury rate than male. Although a general fitness test may not be associated with a history of knee injury (Schmitt et al, 2016), little is known about the effect of physical fitness on ACL injury occurring in female basketball players. The purpose of this study was to investigate if there was an association between ACL injuries and the baseline of physical fitness for uninjured female basketball players.
Methods
Twenty-four female medical school basketball players participated in this study. All students performed physical fitness tests including 30 sec sit-up test, sit-and-reach flexibility test, standing broad jump, 20 sec side-step test and the 20 m shuttle run test. Five ACL injuries occurred in the 24 athletes during one of the basketball games during this research term. The demographics of ACL injured athletes were comparable to uninjured athletes (age: 22.6 ± 0.9 vs 21.1 ± 1.9 years, height: 163.8 ± 3.4 vs 162.6 ± 3.7 cm, weight: 58.9 ± 3.9 kg vs 56.5 ± 6.4 kg, and years played: 10.6 ± 1.5 vs 7.7 ± 4.3 years, respectively). Differences in the physical fitness tests performed in their freshman year between the ACL injured and uninjured athlete group were compared using multivariate logistic regression analysis at an alpha level of 5 % ($p < 0.05$).
Results
The means of sit-up test for the ACL injured group and uninjured group were 25.0 ± 4.0 vs 25.5 ± 4.2, respectively. The means of sit-and-reach flexibility test for the two groups were 56.2 ± 6.3 vs 49.5 ± 7.1 cm, respectively. The means of standing broad jump for the two groups were 173.0 ± 26.2 vs 180.9 ± 14.8 cm, respectively. The means of side-step test for the two groups were 44.8 ± 9.0 vs 50.7 ± 6.2, respectively. Finally the means of shuttle run test for the two groups were 65.0 ± 8.9 vs 61.8 ± 19.3, respectively. All physical fitness tests were not significantly associated with sustaining ACL injury in multivariate logistic regression analysis.
Discussion
This study demonstrated that the physical fitness tests were not associated with ACL injury prediction in basketball. The results were consistent with the previous report with alpine skiers (Schmitt et al, 2016). However, Raschner et al. (2012) suggested that core strength be

a predominant critical factor for ACL injury prevention in young ski racers. Therefore, more specific physical fitness tests or screening tests needed to be identified as physical factors relevant to ACL injury prevention.
Contact
kagaya@nr.showa-u.ac.jp

ILIOTIBIAL BAND STRAIN IS AFFECTED BY SEX AND POSITION

KIM, D.1, MIYAKAWA, S.2, FUKUDA, T.2, TAKEMURA, M.2
UNIVERSITY OF TSUKUBA

Introduction
Iliotibial band syndrome (ITBS) is the second most common knee injury, which is also well-known as running related injury (Taunton et al, 2002). Recently, it is suggested that abnormally increased compression forces between the iliotibial band (ITB) and lateral femoral epicondyle (LFE) cause irritation and inflammation to tissues under the ITB. And excessive strain of the ITB was considered to increase the compression force (Fairclough et al., 2006). Genu varus alignment and sex have been regarded as a risk factor of the ITBS (Taunton et al., 2002). However, the relationship between these factors and the ITB strain is not well-understood. The purpose of this study was to identify sex difference of the ITB strain in different position with or without genu varus.
Methods
Forty healthy recreational level athletes (18 men, 22 women) who have no previous or current knee injuries participated in this study. Data of the alignment in lower extremities and the ITB strain were collected from the right side. We measured intercondylar distance on femur (IC), Q-angle, leg heel angle (LHA) and navicular drop distance (ND). After then, subjects were divided into four groups according to the sex (men; M, women; W) and IC; Genu varus group (GV) ≧4cm in IC, Control group (CON) <4cm in IC (MGV, MCON, WGV, WCON). The ITB strain was measured using an real-time tissue elastography (RTE) on standing (S) and side-lying positions with 4 different postures; Neutral (N), Knee Flexion (KF), Hip Adduction (HA), and Hip Adduction/Knee Flexion (AF). The RTE undertook the estimation and visualization elastic properties of the tissues using the ultrasonography. One way ANOVA was used to examine the differences in groups and positions.
Results
Strain measurements were performed three times by the same examiner and the intra-investigator reliability of the RTE measurements was 0.736-0.925. As for knee flexed position (KF, AF), men groups (MGV, MCON) showed greater strain than women groups (WGV, WCON) ($p<0.05$). However, as for standing position, WCON showed significantly greater strain than MCON ($p<0.05$). On standing position, women gropus (WGV, WCON) have significantly greater ITB strain compared with N or HA.
Discussion
The results showed that the ITB strain was different between the sex. In this study, women showed greater strain than men on weight bearing. It is reported that women are two times as likely to sustain ITBS compared to men (Taunton et al., 2002). From this results, it is considered that greater ITB strain with weight bearing could contribute to the ITBS. Sex differences in muscle activities and the lower extremities alignment during standing could influence to the ITB strain. Therefore further study is required to examine the contributing factors to the increasing ITB strain.
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Contact
Dayoon1226@gmail.com

THE ASSOCIATION BETWEEN TRANSVERSE ARCH AND INJURY OF ANKLE OR KNEE IN COLLEGE SOCCER PLAYERS

NAKAYAMA, Y., TASHIRO, Y., SUZUKI, Y., TASAKA, S., MATSUSHITA, T., MATSUBARA, K., KAWAGOE, M., SONODA, T., YOKOTA, Y., AOYAMA, T.
KYOTO UNIVERSITY

Introduction
It is important to evaluate transverse arch(TA) that have function for shock absorption from ground because it is related to medial tibial stress syndrome (Kudo, et al. 2015). Injury of soccer players occurs to ankle or knee most frequently (Herrero, et al. 2014) and there are some studies that physical characteristic of lower limb is related to injury of soccer players. However, the association between TA and injury of soccer players wasn't investigated. Therefore, the purpose of this study was to examine the association between physical characteristics of lower limb including TA and ankle or knee injury of soccer players.
Methods
This study intended for 62 college soccer players. Demographic data and previous injuries of ankle and knee with one year were obtained by questionnaires. We measured TA, range of motion(ROM) of ankle dorsiflexion (knee extended, bented), toe grip strength, medial longitudinal arch, leg heel alignment, Q-angle and Sway of center of gravity(SCG). TA was evaluated using weight-bearing plantar ultrasound imaging device. We calculated the length between medial sesamoid bone and 5th metatarsal head (MS5M) and length of perpendicular line from 2nd metatarsal head to the line of MS5M (2ML), and used the percentage of both (2ML/MS5M×100) as parameter. In SCG, trace length of center of gravity (TLCG) during one leg standing was measured, using stabilometer. For statistical analysis, all feet were divided into two groups (injury, normal). The differences between groups were compared by unpaired t-test. In addition, logistic regression analysis was conducted for relationship between the injury and TA, adjusted for other factors.
Results
There are 47 feet (38%) in injury group. In injury group, TA was lower than normal group. In addition, in injury group, ROM of ankle dorsiflexion with knee extended was less and TLCG was greater than in normal group. In logistic regression analysis, TA was independently associated with the injury.
Discussion
This study indicated that TA is independently related to ankle or knee injury of soccer players. As for soccer kicking, the reaction ground force of three times body weight occurs vertically (Ball K. 2013) and the force depends on only one leg. TA has functions of shock absorption from the ground. Therefore, low TA induced over load on foot, which could cause the ankle or knee injury.
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THE EFFECT OF A NOVEL DYNAMIC TAPE ON PERFORMANCE IN INDIVIDUALS WITH CHRONIC ANKLE INSTABILITY

KODESH, E.

UNIVERSITY OF HAIFA

Introduction
Ankle sprain is a common temporary musculoskeletal injury, however a high proportion of patients develop chronic ankle instability (CAI). The sensorimotor deficits in CAI include decreased proprioception, strength, neuromuscular and postural control. Despite the significant increase in the use of kinesiotape (KT) for athletic injuries in the last decade, evidence regarding the contribution of KT is inconclusive. Recently, a novel dynamic type (DT) has been developed which claims to improve muscle performance. This tape is applied when the muscle is aligned in a short position. The aim of this study was to evaluate the effect of DT on dynamic stability and power performance among individuals with chronic ankle instability.
Methods
Eighteen participants, aged 25.056(±3.87) years, with CAI participated. Power performance was evaluated using two jump tests ((drop jump (DJ) and three hop test (THT)). Four jump tests (SJT) were performed sequentially on one leg, and displacement on the vertical and horizontal axes were measured in order to evaluate dynamic stability. All tests were repeated 3 times without taping (BL), 10 minutes after taping (T), and 24 hours after tape application (24T) to the Gastrocnemius muscle. A repeated measure model was used to find differences in performance at the 3 time points. Spearman correlations were performed to assess relationships between CAI and jump performance.
Results
DT improves performance of THT 10 min and 24 hours after of tape application (P=0.014). A tendency toward significance (P= 0.076) was found in the improved DJ performance 24h after tape application. Dynamic stability was not affected using this tape. High Positive correlations were found between CAI severity and baseline jump test performance (THT r=0.62; p>0.008; DJ r=0.75; p>0.001).
Discussion
DT applied on the Gastrocnemius muscle improved jump performance tested 24 hours after application among individuals with CAI. This was not accompanied by higher dynamic stability.

MUSCLE ACTIVITY IN CHRONIC EXERTIONAL COMPARTMENT SYNDROME: A CASE-CONTROL STUDY

ROBERTS, A., ROSCOE, D., HULSE, D., BENNETT, A., DIXON, S.

DEFENCE MEDICAL REHABILITATION CENTRE

Introduction
Military and athletic populations are at risk of developing exercise-induced leg pain including chronic exertional compartment syndrome (CECS). This particular condition is associated with an increase in intramuscular compartment pressure (IMCP; Roscoe 2015). IMCP is also strongly associated with muscle activity. Over-activity has therefore previously been hypothesised to be a causative factor in the development of CECS or the main cause of pain in anterior CECS. The aim of this study was to investigate the differences in muscle activation between cases with CECS and asymptomatic controls.
Methods
Surface electromyography (EMG) of Tibialis anterior and Gastrocnemius medialis of 20 male cases with bilateral anterior CECS and 20 pain-free controls was measured during walking and marching. Wavelet analysis was used to describe the power of the EMG signal in the frequency and time domain (von Tscharner 2000) and normalised as per Federolf (2012). The EMG intensity between cases and controls during the gait cycle (for left/right and walk/march) was compared using bootstrap t-tests (Lenhoff 1999).
Results
Cases were significantly shorter than controls as reported previously (Roscoe 2015). Within the low frequency EMG wavelets (1-4), for Tibialis anterior, cases had greater intensities between 90% and 5% of the gait cycle (i.e. before and after heel strike). Cases also had greater intensities within wavelets 6-8 between 93% and 98% of the gait cycle. However in both sets of wavelets these differences were not replicated in all analyses. Cases had greater intensities within the medium-high frequency wavelets between 15 and 30% of the gait cycle for Gastrocnemius medialis than controls in all analyses ($p<0.05$). Increased activity of this muscle was also observed for in lower frequency wavelets between 30% and 40%; however the significance of these differences was not as consistent.
Discussion
This is the first study to describe differences in muscle activity in patients with CECS during gait. The lack of consistent differences in the activation of Tibialis anterior suggests that over-activity neither contributes significantly to the higher IMCP observed in CECS, nor is a risk factor for the development of CECS. As such a structural difference is the likely cause of increased IMCP in CECS patients. The increased Gastrocnemius activity is likely related to the increased plantarflexion seen in this typically shorter cohort that is required to increase stride length during military activities (Roberts 2016); but is unlikely to be the direct cause of the increased IMCP.
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IMPACT OF GLUCOCORTICOID DOSE AND CONDITIONING ON EXERCISE RESPONSE AND ADHERENCE IN PATIENTS RECEIVING ALLOGENEIC STEM CELL TRANSPLANTATION

KUEHL, R.

NATIONAL CENTER FOR TUMOR DISEASES (NCT) HEIDELBERG AND HEIDELBERG UNIVERSITY CLINIC

Introduction
An allogeneic stem cell transplantation (allo-HCT) is an intensive treatment for hematological malignancies. Studies have shown that exercise is beneficial in reducing side-effects, e.g. decrease in physical performance and quality of life. However, therapy associated influences, such as glucocorticoid intake or intensity of conditioning/chemotherapy prior allo-HCT, might hamper the rehabilitation pro-

cess negatively. Therefore, we examined whether different doses of glucocorticoids and conditioning affect exercise response and adherence during inpatient treatment.
Methods
Data from the exercise groups of two randomized controlled intervention trials (n=113) were analyzed. The intervention comprised endurance and resistance exercises 3-5x/week during inpatient period for allo-HCT. Patients were classified for glucocorticoid intake (cut-off 9mg/kg Prednisone (GC)) and intensity of conditioning prior allo-HCT (myeloablative (MAC), reduced (RIC), and non-myeloablative (NMC)) and compared regarding exercise response and adherence. Analysis of covariance was applied.
Results
Patients were 51 ± 13 years, 64% were male. The exercise response (endurance and muscle strength performance) was neither significantly affected by GC dose nor by intensity of conditioning. The exercise duration per week was significantly higher in the group with low GC intake (92min/week vs. 71min/week; p=0.01) and patients with low GC intake performed significantly more resistance exercise sessions per week (p=0.02). The exercise adherence was 64% (71min/week) in the MAC group, 54% (84min/week) in the RIC group, and 63% (100min/week) in the NMC group with no significant differences.
Discussion
The exercise adherence was good. Despite higher exercise duration in the low GC group, no difference in exercise response could be found. A possible explanation might be that the exercise intensity was not high enough. Furthermore, it could be assumed that the catabolic effect of GC was attenuated by exercise. The exercise response during allo-HCT was not affected by GC dose or intensity of conditioning. This finding should encourage exercise therapists and physicians to promote exercise in all patients undergoing allo-HCT.

Mini-Orals

MO-PM10 Training and testing: Basketball and rugby

PERFORMANCE PREDICTORS IN ELITE FEMALE BASKETBALL PLAYERS

TORRES-UNDA, J., ESAIN, I., DUÑABEITIA, U., GIL, S.M., GIL, J., IRAZUSTA, J.
UNIVERSITY OF THE BASQUE COUNTRY (UPV/EHU)

Introduction
Success in basketball is dependent on a variety of factors including the physical characteristics and physiological capacities (4). Previous studies associated the game performance of basketball players with the anthropometry and fitness level (5). However, most research has focused on males, and less information is available to describe relevant predictors in female players (2). We hypothesized that performance in female basketball could be predicted using some anthropometric parameters and fitness tests.
Methods
We analyzed the relation between anthropometry (height, body mass, skinfolds, limb perimeters and lengths), physical fitness level (jumping, agility with and without the ball and speed) and game performance (performance index ratio) of 41 female basketball players aged between 18 and 32. All of them played in the first division of the Spanish women´s league.
Results
Teams ranked better in regular season had a smaller mean fat skindfold thickness ($p<0.05$) and spent less time in agility test ($p<0.05$). Height, arm span, greater contracted arm perimeter (CAP) and older age correlated with better performance index ratio (PIR) ($p<0.05$). Multiple regression analysis indicated that combined height, CAP, fat skindfold thickness, age and time in agility test yielded a strong predictor of PIR per time played (R2 0.705, $p<0.001$).
Discussion
According to previous authors (3) taller players performed better in matches than their shorter peers. Arm spam and upper arm circumference were also positively correlated with better game performance. Although several works analyzed the relationship between anthropometry, physical fitness and performance level in basketball players (1), to our knowledge, the current study is the first to design a predictor for basketball performance in terms of PIR per minute. In addition, it was developed with elite performance level players.

MONITORING A PRESEASON PREPARATION PERIOD IN SEMI-PROFESSIONAL BASKETBALL

WELSCH, S., SCHNEIDER, C., VON FINTEL, J., FERRAUTI, A.
RUHR-UNIVERSITÄT BOCHUM

Introduction
Due to the different possibilities of monitoring, we investigated a multidimensional monitoring of physiological and perceptual responses in combination with performance markers. The aim of the study was to examine the effect of preseason conditioning on different monitoring parameters as well as the inter-correlations between markers.
Methods
Preseason training mainly consisted of basketball-specific training (80%) with an average of six sessions/week (mean duration: 105 min) and highest training loads in week 3. Pre- and Post-preseason we assessed sport-specific endurance (VIFT) via 30-15 Intermittent Fitness Test, countermovement jump height (CMJ), 20 m sprint performance (20m), submaximal heart rate (HR) and perceived exertion during a 5-min submaximal shuttle-run in eight semi-professional basketball players (25.0±4.5 yrs, 196±7 cm, 97±13 kg, estimated VO2max: 53.0±1.7 ml/kg/min). Weekly monitoring consisted of perceived stress and recovery (SRSS) assessment, with four items each for physical, mental, emotional and overall stress and recovery [1], HR, RPE, CMJ (Wednesday), muscle soreness (DOMS) and serum concentration of creatine kinase (CK, Friday). Pre-Post differences as well as within-subject correlations [2] between monitoring parameters were analysed using magnitude-based inferences (meaningful effects: d=0.2, r=0.1).
Results
VIFT and HR were clearly improved (VIFT: +1.3 km/h, d=+1.1, p=.019; HR: -16 bpm, d=-1.6, p=.000) at Post-testing while CMJ and 20m changes remained trivial. Weekly HR, CK and DOMS showed continuously decreasing values. SRSS response was highly individual and item-specific without showing clear global patterns. Medium to large within-subject correlations were found between CK & DOMS (r=.57), HR & DOMS (r=.80), CK & muscular stress (SRSS) (r=.46) and DOMS & muscular stress (r=.44).
Discussion

Pre-Post and weekly changes illustrate expectable adaptations, given the sport-specific emphasised training distribution with meaningful changes in endurance related markers, soreness and muscle damage. HR seemed to be largely influenced by muscle soreness, which might result in impaired running economy during the submaximal shuttle run. Response patterns in perceived stress and recovery were highly individual and may reflect temporary effects of training and possibly personal stressors. Furthermore, from a practical perspective DOMS may substitute time consuming and expensive CK assessment, based on their correlation. To further close the gap between monitoring and training prescription, future studies should focus on the development of multidimensional decision support systems.

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Contact
Simon.Welsch@rub.de

KINEMATICS OF LATERAL CUTTING AFTER THE JUDGMENT IN DEFENSIVE BASKETBALL PLAYERS

KAMEDA, M., KIBA, K., MAEDA, A.

NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

Introduction
In a basketball game, a defensive player is often outrun by an offensive player, because the defensive player loses balance when the offensive player changes running direction. Thus, it will be important to clarify the strategy for performing lateral cutting maneuvers under the unanticipated condition for improving performance of the defensive player. This study aimed to compare the kinematics of lateral cutting maneuvers during the side steps under the preplanned (PRE) and unanticipated (UN) conditions in defensive basketball players.
Methods
The participants were 14 college basketball players. In the experiment, participants were provided the sigh of an arrow directing either the right or left on a monitor in front of them while moving with side steps toward the right. When the right directed arrow was provided, they moved for 3 m by side steps to the right. Conversely, when the left directed arrow was provided, participants moved for 3 m to the right, performed lateral cutting to the left, and moved back to the starting spot with side step. The participants performed trials in two conditions: 1) PRE condition: Participants was informed beforehand the direction of the arrow signal. 2) UN condition: Participants responded to randomly provided direction of the arrow signal. Coordinates of markers affixed to participant's body were collected using a motion capture system (300 Hz). The data only in lateral cutting trials were analyzed from the instant of the foot strike on the ground to the instant of the toe-off during lateral cutting.
Results and Discussion
The results showed that the 3 m side step shuttle time (the duration from starting point to come back there) and foot contact time during lateral cutting in UN was longer than those in PRE ($p < 0.01$, respectively). The center of gravity (CG) lateral velocity toward the right at the foot strike of the cutting step was higher in UN compared to PRE ($p < 0.01$). In UN, CG positioned relatively right (contrary to the cutting direction) ($p < 0.01$) and right lower limb and trunk inclined smaller to the left compared to PRE ($p < 0.05$, respectively). The current results show that, in UN, participants could not decelerate their lateral velocity before the cutting step and not position their foot on the ground far from CG, possibly resulting in smaller lateral force toward the left, prolonged contact time and lower shuttle time in UN. Moreover, the right leg and trunk lateral lean angles seem to affect the position of CG, supporting findings of Lee et al. (2016), and could be important factors for better lateral cutting maneuver in UN condition.

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Contact
kameda@nifs-k.ac.jp

USEFULNESS OF A SUBMAXIMAL SHUTTLE-RUN IN WEEKLY MONITORING OF SEMI-PROFESSIONAL BASKETBALL PLAYERS

VON FINTEL, J., SCHNEIDER, C., WELSCH, S., FERRAUTI, A.

RUHR-UNIVERSITÄT BOCHUM

Introduction
Measuring heart rate at submaximal intensity (HRsubmax) is suggested to be of high value in monitoring training due to its time-saving implementation during warm-up [1]. Aim of the study was to evaluate whether HRsubmax monitoring is able to display changes in sport-specific endurance and perceived stress and recovery dynamics to inform about athlete's state during a seven-week preseason period.
Methods
Fourteen semi-professional basketball players (VO2peak 52.1 ± 2.67 ml/min/kg) were tested on a weekly basis during a seven-week preseason period. Sport-specific endurance (30-15 Intermittent Fitness Test) was conducted before (Pre) and after (Post) preseason. Recovery and stress (RS) state was assessed each Wednesday using the Short Recovery and Stress Scale for Sports (SRSS) at the beginning of each training sessions [2]. SRSS contains four different dimensions in both recovery and stress scale (physical, mental, emotional and overall recovery/stress). SRSS was followed by a 5-min shuttle-run (9, 10.5 and 12 km/h for 1, 1 and 3 min respectively) to asses HRsubmax (average of the last 30s). Data were analysed using magnitude-based inferences (correlation and reliability, [3]) and contingency tables (sensitivity, specificity and accuracy).
Results
Changes in sport-specific endurance and HRsubmax were largely correlated (r=0.63). Reliability analysis of weekly HRsubmax showed a mean net difference of 4.2 bpm, r=0.91, typical error=2.7%. Sensitivity of HRsubmax for changes in perceived recovery and stress varied among the different SRSS items including the highest values for overall recovery (OR) and overall stress (OS). Results from the contingency tables for an improved RS state (sensitivity: OR 78%, OS 63%; specificity: OR 57%, OS 50%; accuracy: OR 63%, OS 53%) differ from those results for an impaired RS state (sensitivity: OR 44%, OS 20%; specificity: OR 83%, OS 73%; accuracy: OR 72%, OS 56%).
Discussion
Weekly measured HRsubmax was highly reliable but only a limited relationship to preseason changes in sport-specific endurance was observed. Sensitivity of HRsubmax for RS state changes was highly dependent on direction of change (improvement vs. impairment) and the different SRSS items. Despite its limited accuracy, HRsubmax appeared to be more sensitive to inform about RS state improvements

than impairments. In conclusion, the usefulness of a submaximal shuttle-run to monitor changes in sport-specific endurance or RS state is limited and should be complemented by additional tests for a trustworthy decision making.

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Contact
Jan.vonfintel@rub.de

NO CORRELATION BETWEEN ANKLE DORSIFLEXION RANGE OF MOTION AND VERTICAL JUMP HEIGTH IN MALE ELITE YOUTH BASKETBALLPLAYERS

SEMPF, F., GLAGE, G., BRAHMS, C.M., THIENES, G.

GEORG-AUGUST-UNIVERSITY GÖTTINGEN

Introduction
Limited ankle dorsiflexion range of motion (ADROM) has been shown to alter jumping mechanics in a non-favorable way (Fong et al., 2011; Papaiakovou, 2006) and may also negatively affect vertical jump performance (Papaiakovou, 2013). Therefore, the purpose of this study was to investigate if ADROM is correlated with uni- and bilateral counter movement jump (CMJ) height in male youth elite basketball players.
Methods
28 male basketball players (height = 184.79 ± 10.44 cm, weight = 77.46 ± 15.01 kg, age = 15.96 ± 1.62 years) were tested for their ADROM using the weight bearing lunge test as described by Bennell et al. (1998). Subsequently, their left and right uni- and bilateral CMJ height was assessed with a contact mat (Bewig Messtechnik). The relationship between ADROM and CMJ was computed using Pearson's r.
Results
The group means for ADROM, unilateral CMJ and bilateral CMJ were 11.58 ± 2.7 cm, 35.96 ± 5.23 cm, and 52.75 ± 7.78 cm respectively. No significant correlations were found between left ADROM and left unilateral CMJ height ($r = -0.015$, $p = 0.939$), right ADROM and right unilateral CMJ height ($r = 0.122$, $p = 0.536$), or mean ADROM and bilateral CMJ ($r = 0.137$, $p = 0.495$) and unilateral CMJ height ($r = 0.071$, $p = 0.724$).
Discussion
Although ADROM has been identified to play a role in the etiology of lower extremity injury (Amraee et al., 2015; Gabbe et al., 2004), it does not significantly influence vertical jump performance in young male basketball players. It is likely that alternative motor strategies compensate for the lack of ADROM (Fong et al., 2011; Papaiakovou et al., 2006). Future research needs to investigate if these results are task-specific or if ADROM affects other performance-related tasks such as sprinting.

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COMPARISON OF DEFINITIONS OF GPS HIGH SPEED RUNNING METRES AND THEIR CORRELATION WITH TRAINING LOAD

LAWLOR, M.

INSTITUTE OF TECHNOLOGY, CARLOW

Introduction
The aim of this study was to investigate definitions of high speed running metres (HSRM) measured by GPS (Optimeye X4, Catapult, Austrailia) and determine if there is a correlation between definitions of HSRM and internal training load (sRPE). Various definitions of HSRM have been used from 60% of individual maximum velocity (Vmax) to an arbitrary value such as 5.0ms-1, (Reardon et al, 2015). Recently, maximum aerobic speed (MAS) has been demonstrated to be a determinant of distance covered in Rugby Union, (Swaby et al, 2016) and therefore a key performance indicator. As sRPE has been shown to be a valid indicator of the training response (Casamichana et al, 2013) this study proposes to validate individual HSRM thresholds.
Methods
Participants (n=16) who were members of an elite rugby union academy wore 10 Hz GPS units during training sessions (n=6). Internal training load was determined using the formula: sRPE x Time (mins) = TL (AU). GPS data were retrospectively analysed using 3 different definitions of HSRM (60% Vmax, 5.0 ms-1, MAS) and distance (m) for each session above threshold was reported.
Results
There was a weak correlation between HSRM above 5.0 ms-1 and training load, ($r=0.431$, $p<0.05$). There was a moderate correlation between HSRM above 60% Vmax and training load, ($r=0.518$, $p<0.05$). There was a moderate correlation between HSRM above MAS and training load, ($r=0.574$, $p<0.05$). There was a significant difference between distances above each threshold, ($F(2,188)=30.083$, $P<0.05$). There was a weak correlation between MAS and distance covered above MAS, ($r=0.222$, $p<0.05$). There was a weak negative correlation between 60% Vmax ($r=-0.124$, $p>0.05$).
Discussion
The results would suggest that individual thresholds of HSRM are more practically applicable in GPS monitoring than arbitrary values as they correlate to training load response. MAS and maximum velocity show a weak positive and negative correlation respectively between distance covered above each threshold. Further study is required.

THE FREQUENCY, INTENSITY, DURATION AND VOLUME OF TRAINING AND MATCH PARTICIPATION OF ELITE YOUNG RUGBY PLAYERS IN DIFFERENT PHASES OF THE SEASON

HENDRICKS, S.1,2, TILL, K., WEAVING, D.1, POWELL, A.3, KEMP, S.3, STOKES, K.4, JONES, B.1

1: LEEDS BECKETT UNIVERSITY, UNITED KINGDOM 2: UNIVERSITY OF CAPE TOWN, SOUTH AFRICA 3. ENGLAND RUGBY FOOTBALL UNION, UNITED KINGDOM 4. UNIVERSITY OF BATH, UNITED KINGDOM

Introduction
Understanding the frequency, intensity and volume of training and competition of adolescent athletes can be used to maximise the potential benefits and minimise the negative consequences of sports participation (e.g., injury). Limited studies have quantified the training and competition demands of adolescent rugby union players. Therefore the purpose of this study was to report the frequency, intensity, duration and volume of rugby training and competition, alongside participation in other activities of adolescent rugby union players across different phases of the season.
Methods
The study used a cross-sectional study design where 497 adolescent (Under 15 and 16 year old) players self-reported their frequency, intensity and duration of i) playing Rugby Matches, ii) participation in Rugby Training, and iii) participation in Other Sports during different phases (September to December [Sept-Dec], January to April [Jan-Apr], May to August [May-Aug]) of the season. Analysis of variance and Cohen's effect size (ES) statistics was used to compare frequency, intensity, duration and volume of participation between phases of season.
Results
The volume (frequency x duration) of Rugby Matches played differed between Sept-Dec and May-Aug (116±57 vs. 33±60 minutes, $p<0.001$, ES = 1.40, large), and Jan-Apr and May-Aug and (97±61 vs. 33±60 minutes, $p<0.001$, ES = 1.07, moderate). The volume of Rugby Training differed between Sept-Dec and May-Aug (337±163 vs. 138±118 minutes, $p<0.001$, ES = 1.39, large), and Jan-Apr and May-Aug (282±166 vs. 138±118 minutes, $p<0.001$, ES = 0.99, moderate). The frequency of sessions for Other Sports differed between Sept-Dec and May-Aug (1.9±1.0 vs. 2.8±1.5, $p<0.001$, ES = 0.71, moderate).
Discussion
Adolescent rugby union players undertake the majority of their rugby activities (Rugby Matches and Rugby Training) between Sept-Dec, during which time their participation is lower in Other Sports in comparison to other times of the year (i.e., May-Aug). Adolescents athletes of this age would likely benefit from participation in other sports, avoiding early specialisation, which appears to take place due to the seasonal nature of the sport. This is despite this rugby playing cohort participating at a representative level. The findings of this study provide an improved understanding of the sport participation demands of representative adolescent rugby players and can be used to inform player management and training prescription, considering their engagement and exposure with other sports.
Contact
sharief.hendricks01@gmail.com

Mini-Orals

MO-PM13 Coaching: Team sports

QUANTITATIVE MEASURED CHANGES OF PLAY BY LIMITED RULES - FROM CHILDREN'S BALL PASSING GAMES –

TAZUKE, S.1, GOUDA, N.2, TANAKA, T.3, FUCHITA, K.1

1:DOSHISHA UNIVERSITY(KYOTO, JAPAN), 2 AND 3:HITACHI,LTD.(TOKYO, JAPAN)

Introduction
A ball game coach requires the player to find free space and move at the best timing although it is not always successful. There is a possibility that controlling a rule of the game would contribute the coach's request. However there is no quantitatively study conducted before. The purpose of this study is to achieve the quantitative data on changes of the play affected by controlling the rule of the game.
Methods
Samples were 12 children (6 boys and 6 girls, aged 12±0.95 years). The experiment was conducted based on ball passing game by 2 teams of 6 players each. Players keeping the ball were only allowed pivot step. Total of successful pass of the ball was competed in the game. Games were played by 4 rules; no rule (rule A), bound pass only (rule B), superior team limited only bound pass (rule C) and game scored only when pass cross the court line divided by four (rule D). 4 factors (running frequency: RF, average running time: ART, average exercise intensity METs: METs and running rate: RR) were calculated with the measured data by Three-Axis Acceleration Bracelet. Each difference between 4 rules and 4 factors were evaluated by mean difference and standard deviate (SD).
Results
The differences between rule A and B were RF:11.17±4.06 times, ART: 0.04±2.75 sec, METs:0.02±0.84 METs and RR: -0.01±0.09 %. The differences between rule A and C were RF: -16.58±6.92 times, ART: 0.16±3.03 sec, METs: -0.08±0.56 METs and RR: -0.02±0.05 %. The difference between rule A and D were RF: 6.92±5.88 times, ART: 2.26±3.36 sec, METs: 0.08±0.53 METs and RR: -0.06±0.06 %. 3 samples scored more than double SD. They were 1) ART by rule D, 2) RR by rule B, 3) ART by rule B and RR by rule C.
Discussion
There are changes of play by rules controlled in terms of ART and RA. What limited rules affect the play differs by players. This study is the first quantitative study investigated the changes of ball passing game play controlled by rules. It shows that there are changes of play by limited rules.

COMPETITION DYNAMICS OF DEFENDER VERSUS ATTACKER IN 1 VS. 1

TSUTSUI, K., SHINYA, M., KUDO, K.

THE UNIVERSITY OF TOKYO

Introduction
Among modern humans, the pursuit and interception of moving targets plays a major role in a variety of sports, such as football, rugby, and hockey. In particular, defenders have to catch attackers making erratic and evasive maneuvers. Studies of intercepting moving

targets have suggested that human uses a constant bearing (CB) strategy (Fajen & Warren, 2007), a time-optimal solution to catch targets, combining information of position with velocity. However, it is still unknown whether human also uses CB strategy to intercept erratically moving target. Here, we examined whether defenders trying to catch such erratic attacker also used CB or not.
Methods
Participants were 12 healthy males (21.1 ± 2.7 yrs). Experiment was conducted on the field. The dimensions of the field were 11m×11m (width×length). The objective of the attacker was to get past the defender and to reach the end line behind the defender, while the objective of the defender was to touch the attacker with both hands. The experimental task began with the start cue. No additional instruction, such as time limit, was given to participants. There were 60 trials. The positions of the attacker and defender were recorded on high speed cameras at 120 frames/s and their head positions were calculated by 3D direct linear transformation method. We evaluated the fit of the CB model with the defender by correlation coefficient and residual.
Results
We found that the CB model could reconstructed defenders trajectory except for the time series where sudden directional change in the trajectory occurred (r= 0.67±0.25 m/s , $p < 0.01$ and residual = 30.2±4.5 m/s). The best fits were produced by a delay of $\tau = 222$ms in mean correlation coefficients and a delay of $\tau = 262$ms in residual.
Discussion
We showed that human interception behavior was successfully explained by the CB model. Moreover, we revealed the time delays of best fit. This time delay was reported as an estimate of the reactive latency in animals, including visuo-motor latency through their nervous system and physical latency such as locomotor delay (Ghose et al., 2006). Interestingly, the defender's delay time was about the same as the human reaction time. This result suggests that defenders compensate for the locomotor delays by predicting the movements of attackers.
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Contact
k.tsutsui6@gmail.com

PLAYER ROTATION FACTORS AND INDIVIDUAL CHARACTERISTICS INFLUENCE PHYSICAL AND TECHNICAL PERFORMANCE IN PROFESSIONAL AUSTRALIAN RULES FOOTBALL

COUTTS, A.1,2, DILLON, P.1, RYAN, S.1,2, HOCKING, J.2, KEMPTON, T.2
1: UNIVERSITY OF TECHNOLOGY SYDNEY (UTS), 2: CARLTON FOOTBALL CLUB

Introduction
Player rotation strategies in Australian football matches have been widely reported to impact player and team performance. Over the last 15 years there have been considerable changes in the strategic (tactical) use of player rotations, resulting in the introduction of new rules that limit their use during a match. There have been relatively few investigations into the interactions between technical and physical dimensions of performance within player rotations during AFL matches. Therefore, the purpose of this investigation was to examine the effects of match-related and individual player characteristics on activity profile and technical performance during rotations in professional Australian football.
Methods
Global positioning system data and player rating scores were collected from 33 professional Australian football players during 15 Australian football League matches. Player rating scores (relative rating points) were collected from the official statistical provider of the national competition and then time aligned with their relative total and high-speed running (HSR) distance (>20 km/h) for each on ground rotation. Individual players' maximal aerobic running speed (MAS) was determined from a two-kilometer trial. A multilevel linear mixed model was used to examine the influence of rotations on physical activity profiles and technical performance during match play.
Results
Rotation duration and accumulated distance resulted in a trivial-to-moderate reduction in relative total and HSR distances as well as relative rating points. The number of disposals in a rotation had a small positive effect on relative total and HSR distances and a large positive effect on relative rating points. MAS was associated with a moderate-to-large increase in relative total distance, but had a large negative effect on relative rating points. Previous rotation time, stoppages and the number of rotations in the quarter had a trivial-to-small negative effect on relative total and HSR distances. A greater speed (m·min-1) was associated with a trivial increase in rating points during a rotation, while there was a trivial decrease in relative total distance as rating points increased.
Discussion
The present findings highlighted the need to consider contextual factors when interpreting technical and physical performance data during Australian football match-play and have several practical implications. Specifically, individual player performance during rotations may benefit from a greater focus on developing tactical skills and technical abilities, especially once physical capacities have been developed. With rules restricting the number of rotation numbers a team can use, a large emphasis on developing MAS during the preseason is vital to enhanced physical activity during competition. Player rotation strategies should also give priority to nomadic players who cover greater distances at higher intensities during a match.
Contact
aaron.coutts@uts.edu.au

THE ROLE OF BODY COMPOSITION ON ATHLETIC PERFORMANCE IN MALE AUSTRIAN LACROSSE PLAYERS

HAUER, R., TSCHAN, H.
UNIVERSITY VIENNA

Introduction
Recent evidence suggests that body composition influences athletic performance. However, there is little published data on the relationship between body composition and athletic performance in the sport of lacrosse. Therefore, this study analysis the influence of body composition on performance test results in male lacrosse players.
Methods

Athletic performance parameters of eighteen male Austrian lacrosse athletes (age: 23.1 ±3.9ys; body mass: 80.7 ±9.5kg; height: 180.8 ±0.7cm) were evaluated using a lacrosse specific fitness test battery. The test battery included cardiovascular endurance, maximal strength, linear speed, agility, lower body power, and a lacrosse specific skill test. Further, anthropometric measurements were assessed according the standardized procedures of the International Society for the Advancement of Kinanthropometry. Subjects stretch stature (cm), body mass (kg), 8-site skinfolds (mm), and girths (cm) were conducted to calculate body fat percentage (%BF). To determine the magnitude and direction of the possible relationship between %BF and fitness test parameters bivariate Pearson correlation coefficients (r) were calculated. The magnitude of the correlations was determined using the modified scale of Hopkins (2000). Statistical significance was set at $p<0.05$.

Results

The results of the correlation analyses between %BF (10.5 ±2.0%) and test performances showed a significant high negative correlation for vertical jump (r =-0.671, P =0.002). Further, 36.6m linear sprint (r =0,685, P =0.002), and 1.6km run time (r =0.587, P =0.010) showed a significant positive high correlation. Similar, although not significant, a positive moderate correlation was reported for t-test (r =0,466, P =0.051), and pro-agility-test (r =0,397, P =0.103) values.

Discussion

The results of this study are in agreement with Collins et al. (2014), who reported an evidence between %BF, muscular endurance, and on-field sports performance. Furthermore, results showed significant lower values in power, speed, and endurance test parameters for athletes with increased %BF. These findings support the hypothesis that %BF is linked to several performance indicators. This information can be used to develop targeted interventions aimed at to improve %BF and fat free mass profiles of lacrosse players. Nevertheless, further work needs to be done to determine the impact of body size on game performance.

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Contact

richard.hauer@univie.ac.at

EFFECT OF CONCURRENT SPECIFIC STRENGTH AND REPEATED SPRINT TRAINING ON IGF-1 CONCENTRATIONS IN FUTSAL PLAYERS: EFFECT OF INTRA-SESSION EXERCISE SEQUENCE

PHONGSRI, K.1, TONGNILLPANT, N.2, AJJIMAPORN, A.3, SILALERTDETKUL, S.1

1: SP-SWU (NAKHON NAYOK, THAILAND), 2: SAT (BANGKOK, THAILAND), 3: SS-MU (NAKHON PATHOM, THAILAND)

Introduction

Strength, power, and repeated sprint ability are considered to be an importance for sport performance. Insulin-like growth factor 1 (IGF-1) is a major growth factor that effects on skeletal muscle. However, little is known about the effect of concurrent specific strength and repeated sprint training on IGF-1 concentrations. Therefore the objective of this study was to examine the influence of intra-session sequencing of concurrent specific strength and repeated sprint training on circulating IGF-1 concentrations in futsal players.

Methods

Twelve male university futsal players (20 ± 1 years; VO2max = 54.2 ± 5.5 ml/kg/min, mean ± SD) were randomly assigned to completed two trials consisted of specific strength training (SST) (3 strength exercises x 2 sets at 70% 1-RM with 5 vertical jumps over hurdles (40 cm), each set separated by 3 mins rest) and repeated sprint training (RST) (7 x 2 sets of 30 m maximal shuttle sprints, set separated by 5 mins rest)(SST: RST) or vice versa (RST: SST). Each trial separated by 14 days. Blood samples were collected at before, immediately after, and 30 mins following the concurrent training sessions to determine the level of serum IGF-1 (ELISA), lactate, and blood gas parameters (i-STAT blood gas analyzer).

Results

Serum IGF-1 concentrations in SST: RST were significant higher than in RST: SST at immediately after the concurrent training sessions (SST: RST: 249 ± 50 ng/ml vs. RST: SST: 215 ± 47 ng/ml, $p<0.01$). However, there was no significant difference in IGF-1 concentrations between two trials at 30 mins following the concurrent training sessions. Blood lactate was increased at immediately after and 30 mins after the concurrent training sessions. In addition, blood pH, HCO3-, and base excess (BE) were significantly lower in the SST: RST compared with RST: SST at immediately after and 30 mins following the concurrent training sessions ($p <0.01$).

Discussion

This study demonstrated that SST followed by RST lead to an increase in circulating serum IGF-1 and lactate concentrations. The elevation of IGF-1 concentrations might correlate with the alteration of circulating lactate, pH, HCO3-, and BE. Previous study reported that IGF-1Ea and MGF mRNA abundance were attenuated when repeated sprint immediately preceded resistance exercise (Coffey et al., 2009). Therefore, the result of this study indicating that SST: RST should apply to futsal training session in order to increase the circulating of IGF-1 concentrations.

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Contact

krirkwit@g.swu.ac.th

EFFECT OF PRIOR TRAINING LOAD ON ENDOCRINOLOGICAL AND OXIDATIVE DAMAGE MARKERS IN TEAM SPORT PLAYERS

SLATTERY, K., WALLACE, L., COUTTS, A.

UNIVERSITY OF TECHNOLOGY, SYDNEY

Introduction

In team sports it can be difficult to determine the appropriate training dose to maintain strength, speed and aerobic fitness throughout the competition period without accumulating excessive fatigue. Markers of dysregulation within the hypothalamic-pituitary axis or measures of oxidative damage may provide additional insight into a player's readiness to perform following a prescribed training load.

Methods

A randomly assigned, cross-over experimental design was used to determine the effect of prior training load on simulated match performance in seven male team sport athletes (age 20.3 ± 2.4 y, body mass 80.5 ± 8.1 kg). A 60 min high-intensity intermittent running protocol on a non-motorised treadmill was completed after, either 4 d of increased (HIGH) or reduced (LOW) training loads. Venous blood samples were taken pre-, post- and 2 h post-exercise to assess plasma measures of growth hormone (GH), thyroid stimulating hormone (TSH), free triiodothyronine (FT3) and free thyroxine (FT4). Urine samples were collected at the same time points to measure 15-isoprostane F2t concentration (F2-isoprostane). The two 6 d testing periods were separated by a one-week washout period. Changes in biochemical and performance parameters were analysed using a factorial two-way analysis of variance.
Results
Following the HIGH training load, peak sprint velocity (HIGH 20.76 ± 0.28 km/h, LOW 21.26 ± 0.22 km/h; $p<0.01$, d=-0.69) and total distance covered (HIGH 5495 ± 670 m, LOW 5608 ± 674 m; $p<0.05$, d=-0.17) were reduced during the simulated match protocol compared to LOW. Significant exercise-induced changes in plasma GH ($p<0.001$), plasma TSH ($p<0.05$) and urinary F2-isoprostane ($p<0.01$) were observed from pre to post-exercise. However, despite a 152% greater training load, no difference in these measures were observed between the HIGH and LOW training conditions.
Discussion
Alterations in hormonal and oxidative markers have been successfully used in team sport to assess long-term changes in fatigue and recovery state (Coutts et al., 2007, Finaud etal., 2006). However, in the present investigation, changes in F2-isoprostanes, GH, TSH, FT3 and FT4 were not reflective of the reduced performance capacity associated with an increased between match training load. It is recommended that the selected markers may be more useful to track long-term changes in the recovery/stress state of team sport athletes, rather than acute fluctuations in training load (Steinaker et al., 2005, Finaud et al., 2006).
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Contact
Katie.Slattery@uts.edu.au

OXYTOCIN VARIATION DURING COMPETITION IN TEAM SPORT PLAYERS

CODRONS, E., VANDONI, M., CORREALE, L., FUSAR-POLI, L., JONGHI LAVARINI, G., BRONDINO, N.
UNIVERSITY OF PAVIA

Introduction
Oxytocin (OT) plays a key role in human social behaviours. Team sports may represent a novel and an ideal setting to study OT impact on behaviour. The aim of this study was to investigate the change in salivary level of oxytocin during amateur team sport competitive matches. A secondary aim was to evaluate whether there was an effect of the result of the game (victory vs defeat) or the importance of the game (quarterfinal vs semi-final vs final) on neuroendocrinological changes. To better address the aims of the study we conducted the same experiment in two different kind of sports.
Methods
16 softball players (23,06 ± 6,55 yrs) and 13 volleyball players (6 men and 7 women: 31.4 ± 3.7 yrs) from Italian competitive teams were included in the study. Saliva samples were collected immediately before and after each match. We evaluated the effect of victory and defeat in the softball regular season while we investigated the increase in importance of the game in the volleyball playoff competition. Oxytocin was measured by means of ELISA kit. We conducted repeated measures analysis of variance (ANOVA) with time (pre and post measurements) as the within-subjects variable and the experimental conditions (Softball: victory vs defeat; Volleyball: quarterfinal vs semi-final vs final) as the between-subjects variable. A mixed design ANOVA was used to assess the impact of gender on hormone change.
Results
We observed a significant increase in salivary oxytocin levels in players after the matches in both sports (+33%,$p<.05$); this effect was not mediated by gender in the mixed gender volleyball team. This increase in oxytocin level showed a positive, although not statistically significant, trend: change in oxytocin levels tended to be higher in more decisive matches (quarterfinal: +27.2% semi-final: +29.4%, final: +55.5%). We did not find a significant difference in oxytocin between victory (+19.5%) and defeat (+32.3%).
Discussion
Our results suggest that practicing a competitive team sport is associated with an increase of oxytocin secretion in the team components. Additionally, increase of oxytocin secretion during team sport competition seems to occur independently of result or importance of the game.
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Mini-Orals

MO-PM17 Obesity and bone: mixed session

BONE MINERAL DENSITY OF ELITE LEVEL KENYAN MALE AND FEMALE RUNNERS: PRELIMINARY DATA FROM RED-S STUDY

MOOSES, M.1, HAILE, D.W.2, OJIAMBO, R.2, SUVI, S.1, LANE, A.R.3, PIND, R.1, HACKNEY, A.C.3
1: UNIVERSITY OF TARTU (TARTU, ESTONIA), 2: MOI UNIVERSITY (ELDORET, KENYA), 3: UNIVERSITY OF NORTH CAROLINA (NORTH CAROLINA, USA)

Introduction
Mechanical loading, hormones and metabolism are known to influence bone mineral density (BMD). Elite level Kenyan male and female runners have dominated international running events for decades, however the information about their bone health is lacking despite

reported very low body masses and body mass indexes (BMI) (Mooses & Hackney 2016). The downside of having very low BMI is an increased risk of RED-S conditions developing in both, male and female runners which can have serious health consequences.
Methods
Participants were 26 female (28.7±6.3 yrs; 51.8±5.0 kg; 1.63±0.07 m; 19.5±2.0 kg/m2; IAAF performance score: 1029±132 pt) and 20 male (27.8±3.6 yrs; 58.1±6.0 kg; 1.73±0.05 m; 19.5±1.8 kg/m2; IAAF performance score: 1087±66 pt) high level Kenyan distance runners. Dual x-ray absorptiometry (DXA) (Lunar Prodigy, GE Medical Systems Lunar, Madison, WI, USA) was used to measure areal BMD at the lumbar spine (LS-BMD), total femur (TF-BMD) and total body (TB-BMD). All DEXA scans were performed and analysed by one investigator. Low bone BMD was defined as Z-score between -1.0 and -2.0 and osteoporosis < -2.0 standard deviations (SD) below the expected value age matched reference population (Mountjoy et al., 2014).
Results
Female and male athletes' LS-BMD and TF-BMD were 1.13±0.14 vs 1.17±0.10 g/cm2 and 1.05±0.13 vs 1.18±0.16 g/cm2 respectively. Respective Z-scores for female athletes were (range) -0.62 (-2.7, 1.8), -0.25 (-2.2, 1.4) and -0.47 (-2.0, 0.8), 0.12 (-2.0, 2.3) for males. TB-BMD for female athletes were 1.16±0.1 and for male athletes 1.26±0.1 g/cm2 with the Z-scores 0.39 (-1.3, 2.1) and 0.41 (-0.9, 2.0). 12% of the female and 0% of the male runners showed TB-BMD Z-score between -1. and -2.0. However, TF-BMD Z-score were between -1.0 and -2.0 for 19% female and 10% of the male runners. Additionally, 8% of the female runners presented values < -2.0. In LS-BMD 27% of female and 30% of male runners had Z-score between -1.0 and -2.0. Additionally, 12% of female runners had Z-score < -2.0.
Discussion
Findings show the prevalence of low BMD (Z-score -1.0 or lower) existed in 30% of elite male and 38% of female Kenyan distance runners. These high rates warrant additional investigation into the energy balance, eating disorders, disordered eating and hormonal markers of this cohort to further understand components of RED-S and their effect on elite level endurance performance.
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Contact
Martin.Mooses@ut.ee

EFFECTS OF JUDO TRAINING ON BONES: A SYSTEMATIC LITERATURE REVIEW

CIACCIONI, S., CONDELLO, G., GUIDOTTI, F., CAPRANICA, L.
UNIVERSITY OF ROME "FORO ITALICO"

Introduction
To provide a systematic literature review (SLR) and methodological quality on the osteogenic effects of judo practice.
Methods
A systematic online search was conducted on MEDLINE, ISI Web of Science, Scopus and SPORTDiscus databases (PROSPERO: CRD42016041803). Inclusion criteria were: observational studies and clinical/interventional trials published in English language from inception to June 2016 that considered the following outcomes: bone health, bone mineral density (BMD), bone diameters, bone impact force and bone turnover markers. The extracted data were analysed and systematically graded for their methodological quality.
Results
Thirty-four studies were included. X-ray absorptiometry resulted the most used assessment method (44.1%). Due to potential risks related to selection, information, measurement biases and confounding factors, the majority of studies (79.4%) presented a "fair" quality. In general, site-specific BMD accrual in children, adolescents, adult athletes and in pre- and post-menopausal women practitioners emerged. Bone metabolic markers revealed a hypermetabolic status in high-level judo athletes. The osteogenic stimuli of judo seem to protect athletes from alterations in bone metabolic balance due to weight loss cycling. However, sexual dimorphism was found between male and female judoka in bone diameters and mass, and significant differences in bone breadths emerged between elite and non-elite judoka. The judo fall techniques reduced bone impact force and velocity respect 'natural' fall.
Discussion
Despite the majority of the evidence was "fair", a comprehensive overview of the associations between judo and bone health/status emerged. However, further longitudinal studies and cross-sectional analyses, as well as interventional research are required to increase the consistence of findings.

FACTORS RELATED TO CALCANEAL BONE DENSITY IN WORLD-CLASS RACEWALKERS

GOMEZ-EZEIZA, J., TORRES-UNDA, J., IRAZUSTA, J., GRANADOS, C., SANTOS-CONCEJERO, J.
UNIVERSITY OF THE BASQUE COUNTRY UPV/EHU

Introduction
During a 20-km racewalking event, an elite racewalker can do up to 16.000 steps, suffering an impact in the bone system in each step. Bone density has been associated with injuries, training volumes, sex or age (Hind et al, 2006; Lara et al, 2016); although its relationships with movement efficiency and biomechanics in racewalking are yet to be explored. Therefore, the aim of this study was to analyse whether bone density is related to gait characteristics and racewalking economy in elite racewalkers.
Methods
Twelve world-class racewalkers, all of them with the Olympic qualifying standard, participated in this study. A bone scanner was used for an ultrasonographic assessment of the right foot's calcaneus speed of sound (SOS) and the broadband ultrasound attenuation (BUA). The calcaneus stiffness index (S) was calculated by the combination of SOS and BUA related to racewalkers' age. At 14 km/h (indicative of race pace), racewalking gait variables, including ground contact and flight times, stride length, stride frequency, and the duration of the different subphases (contact, foot-flat and propulsive subphases) were measured. Racewalking economy was calculated as the oxygen cost per distance.
Results
A more efficient racewalking economy was related to a lower calcaneus bone density, measured as SOS (R=0.599, large effect effect, p=0.040), BUA (R=0.699, large effect effect, p=0.011) and bone stiffness (R=0.649, large effect effect, p=0.020). Biomechanically, a longer propulsive subphase was related to a higher calcaneus bone stiffness (R=0.701, very large effect, p=0.011), and to a worse racewalking

economy (R=0.575, large effect), whereas a longer foot-flat subphase was closely related to a better racewalking performance (R=0.701, very large effect, p=0.011), and economy (R=0.747, very large effect, p=0.005).
Discussion
World-class racewalkers characterised by a shorter propulsive subphase, a longer foot-flat subphase and a better racewalking economy, presented lower bone densities than their less efficient counterparts. This highlights the high risk of injury of elite racewalkers strictly following the rules of the sport (which penalises competitors with a visible lost of contact with the ground and without a straightened knee during ground contact), as shorter propulsive and longer foot-flat subphases allow for a better racewalking efficiency and performance, but negatively impact bone stiffness.
Acknowledgements
This study has been supported by a grant from the University of the Basque Country UPV/EHU (EHUA16/12).
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DO AGE AND SEX MODERATE THE PREDICTABILITY OF BMI ON THE FUTURE ONSET OF LBP? A META ANALYSIS WITH MEGA TRIAL

ERHARDT, R.1, EIBL, F.2, SCHWIRTZ, A.1, KREUZPOINTNER, F.1
1 TECHNICAL UNIVERSITY MUNICH, 2 EGYM GMBH (MUNICH)

Introduction
As a multifactorial symptom, many different factors can lead to Low Back Pain (LBP). The overarching goal of this project is to develop an early warning system to detect individuals at risk to develop LBP in the future. Our systematic review [Erhardt et al. 2017] showed that BMI is the most reported predictor. Its predictive power however shows high variability between the different cohorts. Differences between male and female and the effect of age, respectively, lead to the hypothesis that these two factors could moderate the influence of BMI on future LBP.
Methods
In the first step, a meta-analysis synthesised the results of the systematic review. We used a random-effects model to estimate overall, sex-unspecific effect sizes for the overweight and obese group compared to the normal weight group. A subgroup analysis examined the differences of the predictiveness of BMI for future LBP between men and women.
The mega trial, which is still in progress, will prove the hypotheses generated in step one. Based on more than 750.000 gym members in Germany (egym GmbH, Munich), this big data approach will test the hypotheses that age as well as sex moderate the influence of BMI on the future onset of LBP.
Results
The systematic review revealed eleven publications reporting the effect sizes of BMI of eight cohorts. The meta analysis, based on the data of five cohorts, showed an increased overall estimated risk for both, the overweight (RR = 1.131 (CI 1.032-1.240, p=0.008)) and obese (RR = 1.243 (CI 1.104-1.400, $p < 0.001$)) compared to the normal weight reference group. The influence of sex was proved by a subgroup analysis (3 cohorts included) and showed that overweight women have a statistically significant higher risk (RR = 1.219 (CI 1.107-1.343, $p < 0.001$)) than normal weight women, while on the other hand overweight men only show a slightly increased risk RR = 1.033 (CI 0.943-1.131). For the influence of age on BMI only one study was found, [Miranda et al. 2008]. They found an increased risk for overweight > 50 yr and obese in the age groups < 40 yr and 40-49 yr.
Discussion
These results suggest that both, sex and age, could influence the interaction between increased BMI and future LBP. But the low number of the included cohorts and the disparity in their populations limits the validity and representativeness of the meta analysis. The one study on age is not sufficient to obtain an evidence based answer. The huge, homogenous dataset used for the mega-trial will help to answer these questions.
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Contact
romina.erhardt@tum.de

EFFECT OF REGULAR EXERCISE ON VISUOSPATIAL ATTENTION IN YOUNG ADULTS WITH OBESITY

TSAI, C.L., CHUANG, C.Y., WANG, C.H., PAN, C.Y., CHEN, F.C.
NATIONAL CHENG KUNG UNIVERSITY

Introduction
A number of studies have demonstrated that obesity is highly associated with worse attention, visuospatial abilities, and inhibitory control (Martin et al., 2016; Tsai et al., 2016; Wirt et al., 2015). However, no studies have yet been conducted investigating the effects of regular physical exercise on visuospatial attention in individuals with obesity. The aim of this work was thus to examine the differences in behavioral and electrophysiological performance in young adults with obesity with or without the habit of regular exercise when performing the Posner paradigm.
Methods
Forty-five participants were recruited and divided into three groups: healthy-weight group (HW, n=15; VO_2max = 53.29 ± 7.77 mL/kg·min), obesity with sedentary lifestyle group (OSL, n=15; VO_2max = 43.23 ± 6.1 mL/kg·min), and obesity with regular exercise group (ORE, n=15; VO_2max = 58.23 ± 4.93 mL/kg·min), according to their body mass index (BMI) and frequency of exercise (i.e., at least three times each week, 30 minutes at a time, for at least 12 months). Their behavioral and event-related potential (ERP) performance during the Posner paradigm involving visuospatial abilities and attentional inhibition was measured. Dual-energy X-ray absorptiometry was applied to assess whole-body composition.
Results

Behavioral data showed that the OSL group relative to the HW and ORE groups showed significantly longer response times and a worse inhibitory response effect (i.e., invalid RT-valid RT) when performing the Posner paradigm. In addition, the HW and ORE groups exhibited significantly larger P3 amplitudes as compared to the OSL group. However, there were no differences among the three groups in the accuracy rate and P3 latency. These results remained unchanged even when the confounding factor (e.g., VO2max) was controlled for.
Discussion
Although the accuracy rates and the time needed for target stimulus evaluation and detection (i.e., P3 latency) were comparable in the three groups, the ORE and HW groups exhibited better inhibitory control of attention and more efficient allocation of attentional resources (i.e., P3 amplitude) when compared to the OSL group. These findings suggest that young adults with obesity could still obtain neurocognitive advantages with regard to the executive functions involving visuospatial attention through engaging in regular exercise.
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Contact
Tsai Chia-Liang: andytsai@mail.ncku.edu.tw

Mini-Orals

MO-PM30 Assessment and promotion of PA

THE ASSESSMENT OF PHYSICAL ACTIVITY AMONG ADULTS IN KOREA

KO, B.1, SONG, H.1, PARK, S.1, JUNG, J.1, KIM, J.2, LEE, G.3
1: KOREA INSTITUTE OF SPORT SCIENCE (SEOUL, KOREA), 2: MYONGJI UNIVERSITY (SEOUL, KOREA), 3: CHOSUN UNIVERSITY (GWANGJU, KOREA)

Introduction
In measurement and assessment of human physical activity, physical activity questionnaires have been used. However, the validity and reliability of the questionnaires has been controversy issue (Boon et al, 2008). And recently, the objective instruments have been more widely used. Therefore, the aim of this study was to correctly measure the amount of physical activity among Korean adults using accelerometer and to identify the differences among genders and age groups.
Methods
203 Korean adults aged 20-64 years were required to wear an Actigraph GT3M accelerometer for 14 consecutive days. The reliabilities of physical activity measures like average steps (ASD) and energy expenditure per day (EED) between week1 and week2 were obtained using correlations. The mean differences of ASDs and EEDs for two weeks among genders and age groups were analyzed using ANOVA.
Results
Week 1 and week 2 ASDs and EEDs were significantly correlated to each other (r= .665 to .895, P<.001). ASDs of 8033∓2052.5, 7481∓2016.2, 8741∓4014.7, 8815.8∓4032.8 and 11415∓3873.8 Steps/day for two weeks were produced for male age groups (20s, 30s, 40s, 50s and 60s) respectively, ASDs of 7950∓2121.1, 7053∓2117.9, 7967∓2124.4, 7500∓2983.5 and 10301∓3641.7 steps/day for two weeks were produced for female age groups respectively. Differences between genders were not significant but differences among age groups were significant (F=2.902~3.088, P<.05). EEDs of 371∓229.3, 369∓141.6, 443∓267.4, 363∓196.5 and 455∓176.7 Kcal/day for two weeks were produced for male age groups respectively and EEDs of 243∓70.3, 255∓124.1, 279∓117.3, 241∓103.5 and 329∓129.4 Kcal/day for two weeks were produced for female age groups respectively. Differences between genders were significant (F=4.222 to 4.854, P<.05) but differences among age groups were not significant.
Discussion
Actigraph GT3M accelerometer demonstrated acceptable levels of reliability in this study when we measured physical activity of a sample of Korean adults during two weeks. Insufficient physical activity has been indicated as one of the risk factors (Medina et al, 2013). However, the researches about the exact amount of physical activity among Korean adults using objective instruments like accelerometers have not been extensively studied in comparison with advanced countries. So we provided the accurate statistics related to Korean adults' physical activity levels through this study. Further work is required on development of physical activity guidelines for Koreans.
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SCREENING FOR PHYSICAL EXERCISE IN UNSUPERVISED TRAINING.

TAKITO, M.Y., GOMES, A.T.S., BARROS. B.J., COSTA L.A.R.
SCHOOL OF PHYSICAL EDUCATION AND SPORT OF UNIVERSITY OF SAO PAULO

Introduction
In agreement with the specific recommendations, the physical exercise must be adapted to the global conditions of the individual, taking into account the state of health. Inappropriate performance and/or lack of proper supervision can make regular practice harmful to the individual (Warburton et al, 2011). In order to better understand these issues, questionnaires were administered to assess the risk/benefit relationship in regards to exercise, by comparing prevalence of health conditions in supervised and unsupervised physical exercise practitioners and the use of Par-Q.
Methods
Research on clinical history, health care and physical activity practice was carried out from the application of a self-completion questionnaire comprising an anamnesis and additional information about the practice of physical exercise and PAR-Q. The participants were divided into supervised (S) and unsupervised (NS) physical activity. In order to compare the groups, t-test and chi-square were used, the first one for the continuous variables and the second for the categorical ones. The agreement between some variables measured in the anamnesis and the PAR-Q was also evaluated through the kappa concordance test.
Results

The group of 61 women (34%) and 118 men (66%), with the majority of both women and men performing supervised exercise (43% and 57%, respectively). The total number of people in group S was 123 people, while in group NS this number was 56, totalizing 179 people. The mean age of the S group was 37.7 years (±18.2) and 25.6 years (±10.4) in the NS ($p < 0.001$). Only the presence of hypertension was significantly ($x^2 = 4.63$, $p = 0.031$) higher in the S group (16%) than NS(4%). Regarding health care issues, there was no significant difference ($x^2=0.023$; $p=0.89$) between groups S and NS in relation to the periodicity of the check-up. Most of the two groups did not have the habit of having medical check-up (NS:39.6%, S:37.3%). Regarding the PAR-Q, the S group (0.68 ± 0.96) had a mean of positive responses higher than NS (0.41 ± 0.65), $p=0.03$. Lower concordance between the two instruments for having a bone or joint problem (kappa=0.282) or cardiovascular risk indicators (kappa=0.42).

Discussion

In this group, it was identified that individuals that were trainning whithout supervision were younger and had lower frequence of hyperthension. Most practioners did not have the habit of having medical check-up. Despite the recommendation of supervising the exercise due to the presence of diseases, the supervised group, for the most part, did not signal the PAR-Q's proposals, thus denying the existence of the proposed situations. However, among the groups, there was a difference in the sum of positive answers in the filling, evidencing that the unsupervised group presents a lower risk, ratifying the instrument as a screening tool, although the agreement between similar issues was regular.

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EFFECTS OF A 12-WEEK PEDOMETER-BASED WORKPLACE INTERVENTION ON HEALTH PARAMETERS – A PILOT STUDY

LUETKEMEIER, L.1, FRIESEN, D.1, RUESWEG, S.1, KOCH, L.1, FERRARI, N.1,2, GRAF, C.1

1: DSHS (COLOGNE, GERMANY), 2: UK COLOGNE (COLOGNE, GERMANY)

Introduction

Currently occupational health promotion is a major issue for companies because of an increasing workload and more sick leave days of employees. As a countermeasure organizations with office employees focus on the increase of physical activity, for example by allocating pedometers. Up to now only few interventions are evaluated. Therefore, the aim of this pilot study was to examine the effect of a pedometer-based workplace intervention on active living and health parameters of office employees.

Methods

Within a health program employees were asked to overcome a virtual journey from Cologne to New York in teams within 12 weeks (6053.7 km). Before and after the intervention blood pressure, anthropometric data (height, weight, waist circumference) and fitness (VO2max., fitness index) were measured (Oja et al,. 2013). During the virtual journey daily steps (workplace and leisure time) were documented and calculated with a pedometer (OMRON Walking Style IV). Baseline steps were collected with a sealed display to determine the status quo of physical activity.

Results

14 office employees (6 female) with a mean age of 36.9 +/- 9.9 years participated. With an average of 13.2 +/- 2.3 hours of daily wear time steps per day of 7443.6 +/- 2242.1 increased to 8371.7 +/- 2142.5 ($p=0.084$; $d=0.4$). After the intervention there was a significant decrease of systolic blood pressure of 8.3 +/- 9.3 mmHg ($p=0.016$; $d=0.6$) and diastolic blood pressure of 7.3 +/- 6.6 mmHg ($p=0.001$; $d=0.8$). No significant effects were shown of anthropometric data and fitness. 92.3% were motivated to keep or increase the amount of daily steps after the intervention.

Discussion

Within this small study sample there was an increase of daily steps and a decrease of blood pressure, although the employees were allocated into the somewhat active group (7,500-9,999 steps per day; Tudor-Locke et al,. 2008). At both timepoints, participants didn´t reach the international physical activity recommendations of 10,000 steps per day. To achieve more health benefits, the period and distance should be extended and controlled in a randomized control trial with larger groups.

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Contact

l.luetkemeier@dshs-koeln.de

Mini-Orals

MO-SH03 Sport psychology and cognition

VISUAL SEARCH AND TACTICAL BEHAVIOURS OF DEFENSIVE SOCCER PLAYERS

BAGATIN, R.T.1, PADILHA, M.B.1,2, MILHEIRO, A.1, VIEIRA, C.P.1, TEIXEIRA, A.1, RODRIGUES, G.1, TAVARES, F.1, CASANOVA, F.1

(1) CENTER OF RESEARCH, EDUCATION, INNOVATION AND INTERVENTION IN SPORT (CIFI2D), FACULTY OF SPORT (FADEUP), UNIVERSITY OF PORTO, PORTUGAL. (2) SCHOLARSHIP CNPQ - BRAZIL

Introduction

Successful performance in soccer requires perception skills (e.g. visual search behavior) as well as the efficient and accurate motor response (Williams et al., 1999; Savelsbergh et al., 2002). The aim of the present study was to verify if the number of fixations could explain tactical performance of defensive players during small-sided and conditioned games (SSGC).

Methods

Ten amateur soccer players were evaluated (24.18yrs±3.66). The field tests consisted in 2 v 1+GK during SSCG (27x20m) tasks. (Bagatin et al., in press). The soccer players wore a Tobii pro 2 glasses to evaluate visual search behaviour, in which we defined the number of fixation per locations as the visual indicator, and ball, space, space of the player in ball possession, player in ball possession as the locations. The tests were recorded in video to evaluate defensive tactical performance based on soccer tactical core (Teoldo et al., 2009). Multiple linear regression was performed to explain the variance of tactical performance (dependent variable) by visual indicator (inde-

pendent variable) with alpha value (.05), correlation value (r), coefficient of determination (r2) and Beta (β) values presented in multiple linear regression tables.
Results
The regression model displayed statistical significance value (p=.043) of the number of fixations in the "ball" (β=-.742, p=.015; r=.699), in which the visual indicator proposed could explain the tactical performance of soccer players (r2=.671).
Discussion
The results obtained suggested that the number of fixations in the 'ball' could explain the variance of defensive tactical performance. Thus, for each increment of the number of fixations in the ball one unity of defensive tactical performance could decrease.
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THE RELATIONSHIP BETWEEN DIFFERENT METHODS OF TRAININGS AND EXECUTIVE FUNCTION IN JUNIOR SOCCER PLAYERS

SAKAMOTO, S.
NIPPON SPORTS SCIENCE UNIVERSITY

Introduction
Many studies have shown that physical exercise influences on cognitive function. However, also suggest that mindless sports activities (treadmill running, riding a stationary bicycle, or rapid walking) do little to improve it (Diamond, 2016). These studies imply that we must encourage research about the types of physical activity. Several studies suggest that soccer, which is a typical team sport, improves executive function (Alesi, 2016). However, there are few studies focusing on the qualitative aspects of the types of training methods. We evaluated the relationship between different methods of training and executive function.
Method
The total number of the subjects was 130 young soccer players (11-12 years old). We divided them into 2 groups: One that has technical training (e.g. dribbling, feint, shoot) in a soccer team (N=63). The other one has tactical training (e.g. possession game, one side attack game, mini-games) in another team (N=40). Executive function was evaluated by a modified Design Fluency Test.
Result
Using the sum of scaled scores the group of tactical training junior soccer players and the group of technical training junior soccer players, the group of tactical training had higher scores (mean= 8.1, SD 3.4) than the group of technical training junior soccer players (mean = 10.0, SD 3.4) in the task and there was a significant difference between them (t=2.73, df= 101, p=0.007, p<.01.).
Discussion
This result suggests that tactical training contributes to the executive function in children. Executive functions are critical for sports performance (Vestberg, 2012). Therefore, although there are various types of training methods in soccer: tactical training, technical training, resistance training and coordinate training, we should focus on improving the training method which influences executive function from childhood.
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COGNITIVE AND MOTIVATIONAL FUNCTIONS OF SELF-TALK IN ELITE ATHLETES: GENDER AND SPORTS TYPES

HATAMI, F.1, TAHMASBI, F.1, BAGHAIYAN, M.1
1: SRTTU (TEHRAN, IRAN)

Introduction
Self-talk has been defined as "what people say to themselves either out loud or as a small voice inside their head" (Theodorakis, Weinberg, Natsis, Douma, & Kazakas, 2000, p. 254) and has been endorsed by coaches and athletes as one of the most widely used and effective strategies for enhancing sport performance. Self-talk serves two main functions for the athlete, cognitive (instructional) and motivational. The cognitive function relate to assisting the athlete to learn and execute individual skills and strategies. The motivational function helps athletes "psych" themselves up, relax and control their arousal, improve mental toughness, focus, confidence and mental preparation, and overally, helping athletes keep on track to achieve their goals. The purpose of present study was to examine the effects of gender and sports type (team and individual sports) on cognitive and motivational functions of self-talk in Iranian elite athletes.
Methods
165 athletes of different individual and team sports completed the Persian version of Self-Talk Questionnaire for Sports (Zervas, Stavro & Psychountaki, 2007) to assess their use of two cognitive and motivational functions of self-talk. Cronbach alpha and Intraclass Correlation Coefficient was calculated greater than 0.81, that indicated the appropriate internal consistency and temporal reliability of Persian questionnaire. Confirmatory factor analysis showed acceptable model fit for elite athletes.
Results
Results of MANOVA indicated that sports type main effect (p≥0.01) and the interaction of gender and sports type (p≥0.05) were significant but the gender main effect was not significant. Follow up results of a significant interaction effect by running tests for simple main effects showed that In individual sports, there were no significant differences in cognitive (p= 0.088) and motivational (p=0.273) functions of self-

talk between male and female athletes, while, female athletes in team sports used cognitive (p= 0.02) and motivational (p=0.033) functions of self-talk significantly more than male athletes (p≥0.05).
Discussion
These findings suggest that coaches and sport psychologist may use cognitive interventions such as self- talk to improve performance of athletes.
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Contact
fhatami2010@gmail.com

NEURAL CORRELATES OF TEMPORAL DYNAMICS OF COGNITIVE CONTROL IN BADMINTON PLAYERS

LIN, C.C., CHANG, K.Y., LIN, J.T., WANG, C.H.
NATIONAL CHENG KUNG UNIVERSITY

Introduction
The cognitive superiority in athletes has recently been receiving increasing levels of attention. However, the investigations of dynamic changes in behavior and neural activity that support superior behavior in athletes have remained elusive.
Methods
In this study, we employed a flanker task to investigate the temporal dynamics of behavioral performance (i.e., response variability) during cognitive control, in conjunction with electroencephalographic (EEG) oscillations, including theta power and inter-trial theta phase coherence (ITPC). These measures were compared for 16 badminton players and 16 athletic controls who were trained in a sport requiring less cognitive demands (i.e., track-and-field athletes).
Results
Results revealed that badminton players made less variable responses than athletic controls, regardless of level of cognitive control. In terms of EEG measures, both badminton players and athletic controls showed similar modulations associated with cognitive control on frontal midline theta power. However, such an effect on theta ITPC values was observed selectively for the badminton players.
Discussion
The behavior-EEG correlation analysis suggests that the smaller changes in RT variability induced by increasing level of cognitive control in badminton players may be attributable to greater phase coherence in the theta band during cognitive control processing. Taken together, it seems such differences are likely due to training-induced adaptations in a sport requiring higher level of cognitive demands, in line with the idea of far transfer from cognitive components involved in sport training to domain-general cognition.
Contact
[ginalin83225@gmail.com]

A NEUROBEHAVIORAL APPROACH ON INHIBITORY CONTROL IN RACKET VS. TEAM SPORTS ATHLETES

SOGA, K., MASAKI, H., VOGT, T.
WASEDA UNIVERSITY, WASEDA UNIVERSITY, GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Cognitive function is associated with sports performance (Verburgh et al., 2014). Sports athletes need to inhibit unimportant information (i.e. intentional forgetting) and update their memory for superior performances. In addition, different sport types require different sport-specific performances and thus different inhibitory control that may be individual or team-related, for example, in tennis (individual racket sports: mishit) and soccer (team sports: bad pass, possibly played by a teammate). Therefore, we hypothesized that racket sport players should exhibit greater abilities of intentional forgetting compared to non-racket sport players, which should be reflected in central neuronal behaviour.
Methods
Regional-level tennis players (n=17, 26.5 ± 7.7 years, 77.9 ± 12.4 kg) and soccer players (n=15, 23.3 ± 3.1 years, 78.5 ± 8.3 kg) performed a flanker task and an item-method directed forgetting task, using neutral and negative arousing pictures. During an encoding phase (forgetting task), participants tried to memorize or forget pictures according to instructions. During a break between encoding and retrieval times, participants performed a flanker task and had to respond to target stimuli as quickly and accurately as possible. Cognitive functions associated with performance of the flanker task were assessed by event-related potentials (e.g., N2). During a retrieval phase, participants were asked to make old/new decisions on presented pictures regardless of the instructions during the encoding phase.
Results
Behavioural analyses revealed a tendency for higher accuracy of congruent flanker task trials in tennis compared to soccer players (98.9 ± 1.3% vs. 97.4 ± 2.6%, $p = 0.054$); however, changes in performing the forgetting task failed significance ($p > 0.10$). N2 analysis including eligible participants (tennis n=14, soccer n=10) for the flanker task revealed larger N2 amplitude in tennis compared to soccer players for both congruent and incongruent flanker trials over central brain areas (Congruent trials: –0.21 ± 0.64 μV vs. 0.48 ± 0.68 μV, $p < 0.05$; Incongruent trials: –0.65 ± 0.65 μV vs. 0.15 ± 0.60 μV, $p < 0.05$).
Discussion
These findings indicated that tennis compared to soccer players exhibited higher performance of inhibitory control that is also reflected in the N2. The present findings suggest that racket sports players may have a greater ability of overcoming a response conflict that might contribute to an improved cognitive performance of inhibitory control.
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EFFECT OF CONSISTENT PREPARATION BEHAVIOR IN BASKETBALL FREE THROW

NAGATA, N.

KEIO UNIVERSITY

Introduction
Pre-performance routines (PPRs) have been defined as "a sequence of task-relevant thoughts and actions which an athlete engages in systematically prior to his or her performance of a specific sports skill" (Moran, 1996). One of the purposes of PPRs according to Cohn (1990) is "preperformance routines would be to assist the athlete in selecting a motor program from similar stored responses and to define the specific parameters that will achieve the forthcoming motor response." In the present study, this assistive effect of PPRs for athletes was examined in small groups.
Methods
The participants of this study were six male Japanese college basketball players (9.00±0.89 experimental years), whose percentage of shots made and shot hand movement were recorded. Shot movement was analyzed by a three-dimensional motion analysis system. Half of the participants took 20 shots each in two conditions: consistent preparation behavior (CPB) and no-preparation behavior (NPB). Others took 20 shots each in the CPB and random preparation behavior (RPB) conditions. We set a 1-minute rest interval between each trial.
Results
The percentages of successful free throws in each condition were 56.67±0.18%, 63.33±0.13%, and 39.76±0.22% for CPB, RPB, and NPB, respectively. In addition, coefficient variances of wrist and elbow angle in each condition were: CPB wrist vs. RPB wrist, 0.51±0.41% vs. 0.57±0.67%; CPB elbow vs. RPB elbow, 0.10±0.08% vs. 0.15±0.09%; CPB wrist vs. NPB elbow, 0.39±0.13% vs. 0.39±0.24%; and CPB elbow vs. RPB elbow, 0.12±0.06% vs. 0.13±0.09%.
Discussion
These results suggested that preparation behavior assists the players' performances and supported the warm-up decrement hypothesis (Adams, 1961). Regarding the factor of difference in behavioral consistency, no differences existed among joint angles, and RPB had higher shot success than CPB. To interpret this result, individual data were analyzed in detail.
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BEHAVIOURAL OBSERVATION FORM- A PRACTICE-DRIVEN APPROACH TO ASSESS PSYCHOLOGICAL CHARACTERISTICS OF BOXING TALENTS

WALTER, N.1, HEINRICH, A.2, STRAUCH, N.2

1: INSTITUT OF APPLIED TRAINING SCIENCE (LEIPZIG, GERMANY), 2: MARTIN-LUTHER-UNIVERISTÄT (HALLE-WITTENBERG, GERMANY)

Introduction
The assessment of psychological features is a crucial part of holistic talent development. However, in boxing the psychological demands are less known and no boxing specific assessment tool is available. One approach in deriving requirements for young athletes is to analyse features of elite athletes. Therefore, the aim of this study was to identify psychological characteristics in elite boxing and to develop a user-driven tool to assess those features.
Methods
Inspired by the performance profiling (Butler and Hardy, 1992) 16 elite boxers from the German national team (age: M = 24.31, SD = 2.36) and 7 German elite trainers (age: M = 49.57, SD = 7.59) were asked about the psychological characteristics of internationally successful Olympic boxers. They further described boxing specific behaviour related to these features. Sport-psychologists translated the responses into psychological constructs and categorised them into boxing specific dimensions. Based on the behavioural scouting by Löw (2014) the most frequently mentioned features were used to design a boxing specific observation form.
Results
21 characteristics regarding self-regulation, volition, focusing, hard work ethic, self-efficacy, motivation and goal setting were derived and integrated in the form. By means of the mentioned behaviours, the coaches assess the athlete's boxing specific psychological features. Currently the observation form is evaluated and tested within the talent development of the German Boxing Federation.
Discussion
The identified psychological demands are in line with theoretical assumptions (Jancso, 2015) and studies on isolated psychological features in boxing (Wlazlo, 1995; Khani et al., 2011; Zhu et al., 2013). The assessment tool enables the coaches to get a deeper insight in the strengths and weaknesses of youth boxers and allows planning suitable interventions. However, a talent selection by psychological characteristics is not appropriate as little is known on the prognostic validity, the trainability and the development throughout the long-term development process or the interactions with other talent features (Anshel & Lidor, 2012).
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Contact
walter@iat.uni-leipzig.de

COPING WITH STRESS AND INJURY IN COMPETITIVE POWERLIFTING

PAVELIC, M., LINTUNEN, T.
UNIVERSITY OF JYVASKYLA

Introduction
Many people have turned to recreational weightlifting as their form of physical activity, which has been associated with an increased prevalence of certain injuries (Metzger et al., 2012). Likewise, competitive powerlifting has seen a rise in participation rates in recent years, according to Powerlifting Australia Ltd. and the International Paralympic Committee. In contrast, research investigating psychological variables in powerlifters is sparse. While much literature exists on coping mechanisms athletes use in the sport context, minimal attention has been focused to study how athletes involved in strength-based sports cope with stress and injury. The nature of strength sports overall differs from contact, speed-based, or even aesthetics-based sports. These essential differences are hypothesised to bring about specific stressors, thereby different coping styles in competitive powerlifting. This study examined athletes in the sport of competitive powerlifting; particularly, the stressors related to training and competitions, as well as experiences with injury, and how they coped with such stressors.
Methods
This study used a cross-sectional, narrative design rooted in Williams and Andersen's (1998) stress-injury model as the primary theoretical lens. Participants were eight (n=8) male competitive powerlifters, specifically from Canada (n=3), the United States (n=2), Hong Kong-China (n=1), Slovenia (n=1), and the United Kingdom (n=1) aged 18-28 years with past physical injury in need of rehabilitation. Data were collected through semi-structured interviews. Thematic analysis was used to synthesise participant interview data.
Results and Discussion
Preliminary results indicated that "making weight," and "hitting expected lifts in time for competition" were common stressors. Most participants (n=7) had previously sustained a lower back injury requiring physical therapy. Problem-focused coping strategies including training around their injured muscle groups and seeking information about their injuries were most commonly reported coping styles. There also appeared to be a precursory pattern in participants who have experienced a major life event shortly prior to an injury that required rehabilitation. Further results and practical implications for strength conditioning and powerlift coaches, and practitioners working with injured athletes will be presented and discussed in light of previous stress- and coping-related literature.
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Contact
Pavelic Marina: map.marina.pv@gmail.com

THE EFFECT OF AEROBIC FITNESS ON FEATURE BINDING PROCESSING DURING WORKING MEMORY IN MALE YOUNG ADULTS

LIN, J.T., CHANG, K.Y., LIN, C.C., TSAI, Y.Y., WANG, C.H.
NATIONAL CHENG KUNG UNIVERSITY

Introduction
Aerobic fitness has been shown to be positively associated with cognitive performance. However, the beneficial effects of aerobic fitness on working memory in young adults remain unclear. One possible reason might be that aerobic fitness has selective effect on specific components of working memory processing. Accordingly, this study aimed to further address this issue by using a feature binding working memory task as well as the event-related potentials (ERPs) approach.
Methods
Behavioral and ERPs performance were recorded simultaneously from 15 male young adults with low level of aerobic fitness (aged 22.93 ± 1.79 years; VO2max = 46.15 ± 4.29 ml/kg/min) and 17 aged-matched high aerobic-fitness counterparts (aged 22.59 ± 1.77 years; VO2max = 60.81 ± 5.00 ml/kg/min) when they performed the feature binding working memory task involving different levels of attentional control (i.e., color only, shape only, and color-shape binding conditions).
Results
Behavioral data revealed no significant differences between groups across conditions in the working memory task. However, the ERPs results showed that the high-fitness group, as compared to the low-fitness counterparts, exhibited smaller P3 areas during memory retrieval stage in the condition requiring higher level of attentional control (i.e., color-shape binding). Such effect, however, was not observed for the other conditions requiring lower level of attentional demands.
Discussion
Taken together, although we did not observe the beneficial effect of aerobic fitness on the working memory task at behavioral level, the electrophysiological indexes suggest that individuals with higher level of aerobic fitness may have relatively greater efficiency in attentional allocation in the task requiring higher level of attentional control.

THE EFFECT OF AEROBIC FITNESS ON RESPONSE VARIABILITY AND POST-RESPONSE CONFLICT PROCESSING IN THE STROOP TASK

CHANG, K.Y., LIN, J.T., LIN, C.C., TSAI, Y.Y., WANG, C.H.
NATIONAL CHENG KUNG UNIVERSITY

Introduction
A growing literature has emerged indicating a positive relationship between aerobic fitness and cognitive control. However, such effect on response variability and post-response conflict processing during cognitive control is largely unknown.
Methods
In this study, behavioral performance and event-related potentials (ERPs) were collected while 15 young adults with high level of aerobic fitness (high-fitness group; aged 22.80 ± 1.93 years) and 15 demographically matched low aerobic fitness counterparts (low-fitness group; aged 22.53 ± 1.85 years) performed a modified color-naming Stroop task.
Results

Behavioral data revealed that, although there are no group-level differences in terms of response accuracy and processing speed, the trial-to-trial response variability is smaller for the high-fitness group. ERP data revealed a post-response conflict slow potential (conflict SP) that differentiated congruent from incongruent trials. Specifically, the amplitude of the conflict SP during the incongruent trial was significantly smaller in the high-fitness group than that of the low-fitness group.
Discussion
The present findings suggest that less attentional resource may be required for post-response monitoring or conflict adaptation in participants with high level of aerobic fitness. These effects, however, were not observed for N2 component. Taken together, these findings indicate that greater aerobic fitness is associated with more stable response during a cognitive control task, which might be attributed to higher efficiency in post-response conflict processing.
Contact
tofu8888e@gmail.com

Mini-Orals

MO-SH04 Leisure activity and health

A BIG DATA ANALYSIS PERSPECTIVE: THE QUANTITY AND QUALITY OF STRUCTURED EXERCISE WITHIN HEALTH AND WELLNESS CLUBS

BENVENUTI, P.1, ZANUSO, S.2, ESSER-HORSHAM, E.3, FEDELE, G.3, DONATIELLO, G.3, SENNI, S.3, NICOLETTA, R.3, CUZZOLIN, F.4

1: UNIVERSITY OF VERONA (ITALY), 2: UNIVERSITY OF COVENTRY (UK), 3 TECHNOGYM SCIENTIFIC DEPT. (ITALY), 4:UNIVERSITY OF PADOVA (ITALY)

Introduction
It is well known that physical inactivity is a major health problem that needs to be solved. Structured exercise executed in health and wellness clubs (HWC) could be an effective solution to counteract this problem. However, there is limited data on a European perspective to know if the volume and intensity of exercise executed in HWC is compliant or exceeds the recommended level of physical activity suggested by international guidelines. Technogym has established a cloud based technology than can automatically track the exercise executed by members using connected devices; this solution helps in overcoming the well known problems related to self-reported data. The aim of this study was that of conducting a baseline descriptive analysis of the 'exercise behaviour' on a large scale involving European HWC.
Methods
Data collected from a representative week of the year 2016 was extracted from the Technogym MyWellness Cloud. During the choosen week, clubs across 31 European countries automatically uploaded data on the wellness cloud trough connected equipment. In the analysis a total of 175.506 subjects were analyzed: 92.145 women (43.1±15.6 years; 67.9±13.9 kg) and 83.361 men (46.5±15.8 years; 83.4±14.7 kg). The total number of analyzed training session was 349.568.
Results
The average session/week attendance at the HWC was 1.92±1.08 for women and 2.07±1.02 for men. The average intensity per session expressed in Metabolic Equivalents was 5.78±1.82 for women and 6.01±2.11 for men. Total volume expressed in METs/h/week was 10.91±8.95 for women and 12.23±10.05 for men. The average weekly duration expressed in minutes was 113.2±81.2 for women and 124.2±89.5 for men. Minutes accumulated during the exercise sessions were divided into Aerobic (women 32.6±16.8; men32.7±18.3), Resistance (women 27.6±16.9; men 32.1±18.8), Flexibility (women 3.32±3.26; men 3.38±3.12) and Body Weight Exercises (women 22.8±20.9; men17.9±17.0).
Discussion
The results of this first preliminary descriptive analysis, shows that in HWC both men and women far exceed the minimum recommended dose of physical activity to be considered moderately active, set at 7.5 METs/h/week. Both aerobic, resistance and body weight exercises are well represented in duration, whilst very little time is devoted to stretching. Considering that this data refers to exercise accumulated within the facilities and not through physical activity, European citizens joining a HWC has to be considered active citizens.
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USER BEHAVIOR ANALYSIS OF OUTDOOR FITNESS EQUIPMENT

WU, D.R., CHOW, H.W., LIAO, Y., CHANG, H.Y.

NATIONAL CHENG KUNG UNIVERSITY

Introduction
Outdoor fitness equipment has become popular in many countries in recent years. They help the public to engage in physical activity in outdoor environment. However, several accidents (injuries) were reported due to the lack of instructions. Misuse of the equipment could cause safety concerns. This study aimed to illustrate the user behaviors of outdoor fitness equipment.
Methods
The videoed data was taken from earlier studies' documentaries in 2012 and 2015. The user behaviors of outdoor fitness equipment from videos were categorized using the Mangold INTERACT Software. Three different pieces of outdoor fitness equipment, including Air walker, Ski machine and Waist and Back Massager, and their corresponding user behaviors were analyzed in this study. Each equipment was observed for three hours.
Results and discussion
The study summarized nine different types of user behaviors for Air walkers, five different types for Ski machine and five different types of behaviors for Waist and Back Massager. The first and second common user behaviors of Air walker were "standing in front of equipment to stride in reverse direction" at 54% and "two legs stride in the same direction" at 24%. The first and second common user behaviors of Ski machine were "stride with side-to-side with hands and legs" at 59% and "stride with same side with hands and legs" at 19%. The first

and second common user behaviors of Waist and Back Massager were "massage back in the vertical direction" at 50% and "massage back in the horizontal direction" at 30%. The study also identified several risky user behaviors of using this equipment that might potentially cause injuries, i.e. not holding the grips or both feet stand on the same pedal. This is the first study that revealed the empirical data regarding user behaviors of outdoor fitness equipment that have significant implications for policy and manufactures.

PHYSICAL ACTIVITY LEVELS IN HEALTHY UNIVERSITY STUDENTS

KUNO-MIZUMURA, M., CORNUS, S., FAVRET, F.

OCHANOMIZU UNIVERSITY

Introduction

Nowadays, high level of inactivity and sedentary lifestyle has spread out for all-ages. Most guidelines for health promotion in different countries recommend to walk more that 10000 steps everyday. Previous studies have examined physical activity level (PA) using tri-axial accelerometer for both children and middle-aged or elderly people. However, information of PA are limited for young adults like university students. So the purpose of this study was to investigate PA measured by objectively using a tri-axial accelerometer in university students from different faculty in different countries, Japan and France.

Methods

One hundred healthy university students participated in this study. Sixty-one students were from faculty of Sports Science or Arts (Dance) in University of Strasbourg (27 males and 34 females) in Strasbourg, France and thirty-nine female university students were from faculty of Letters and Education in Ochanomizu University in Tokyo, Japan. All participants were provided with a tri-axial accelerometer (Active Style-pro, Fukuda Denshi, JAPAN). Daily step totals were summed for each participant's total. We instructed participants not to make changes to their typical daily routines and leisure activities for the duration of the study. More than three days recording for two days during weekdays and one day during weekends were needed to analyze physical activity level of habitual daily life. According to these criteria, the number of subjects for analysis of physical activity level was sixty.

Results

Average step counts were 9744.5 (SD=3028.9), which was almost similar level for university students in previous studies. There was no significant difference by gender or faculty in step counts. Step counts during weekends were significantly less than that during weekdays. In addition, there was no significant correlation between steps counts and the time from home to university. Japanese university students showed significant higher step counts compared to French students. There was no significant difference between sleep time among three different faculties of the students, while students from faculty of Arts (Dance) were tended to stay later at night.

Discussion

Previous studies have reported that step counts of university students were from 8000 to 9000 steps a day. Our findings also coincided with previous studies reported significant difference in step counts between weekdays and weekends. From our results, even for young university students, it is necessary to promote physical activity in this population depending on different temporal characteristics of their life styles.

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Contact

mizumura.mayumi@ocha.ac.jp

EFFECTS OF SHUTTLECOCK KICKING ON BODY COMPOSITION IN PERIMENOPAUSAL FEMALES

DING, H.

GUANGZHOU INSTITUTE OF PHYSICAL EDUCATION

Introduction

The perimenopausal transition has been associated with a decrease in body lean mass, an increase in fat mass, and an increase in body weight. Menopause has an independent effect on an increase in fat mass, and an increase in central obesity in perimenopausal Chinese females.Therefore, precautions should be taken perimenopausal females' Obesity to reduce the morbidity and better their life. Shuttlecock kicking (ti jian-zi) is a popular traditional sport for exercise and fitness in China, the purpose of this study is to explore the influence of shuttlecock kicking on Body composition in Chinese perimenopausal females.

Methods

By randomized controlled study, the 45 community-based healthy perimenopausal females (40～55 Years old) were be randomly divided into Group Ⅰ of 23 females who kicking shuttlecock for 1～3 hours each time and 4～6 times each week, and Group Ⅱ of 22 females who rarely exercise. Soft tissue body composition were measured by dual-energy X-ray absorptiometry(DEXA), Other measures including age, height, body weight(BW),body mass index(BMI),waist circumference(WC)and waist-hip ratio(WHR).After 6 months, observed the changes of the Body composition.Statistics software of spss18.0 was used to calculate and the differences were compared through the matching T examination.

Results

After 6 months,Lean mass of both Legs、Trunk and total body were significantly higher than before in Group Ⅰ, respectively , there were different degrees of decline in Group Ⅱ.Fat mass of both Legs、Trunk、 total body and %fat were significantly lower than before in Group Ⅰ, respectively , there were different degrees of increased in Group Ⅱ.There were significant differences in BW(-0.28kg vs 0.68kg), BMI(-0.06kg/m2vs 0.44kg/m2), WC(-0.73cm vs 1.02cm)and WHR(-0.01 vs 0.01)between the two groups.($P<0.05$, $P<0.01$, respectively).

Discussion

Shuttlecock , consisting of running, kicking, jumping, and swiveling body movements, is a whole body periodic aerobic exercise, mainly involving in movements of lower limbs. When the shuttlecock goes up and down, the kicking leg swings back and forth or inside and outside, the supporting leg supports the total body mass. Repeated mechanical stimulation leads muscle fiber proliferation and fat energy supply increase of the lower limbs and trunk which changes body composition.

Conclusion: Shuttlecock kicking may improve body composition in Chinese perimenopausalf emales.Shuttlecock kicking can have long-term benefits for women undergoing the menopausal transition.These findings can contribute to the future planning of community-based exercise programs for perimenopausal females.

BENEFIT EFFECTS OF 6-HYDROXYMELATONIN SULPHATE AND SLEEP QUALITY BY FITNESS QIGONG IN MIDDLE-AGE WOMEN

HUANG, L.

GUANGZHOU SPORT UNIVERSITY

Introduction
Because of aging, estrogen deficiency and the decline of ovary functions make menopausal women experience a variety of physical changes, including decrease of sleep quality, melatonin, anti-oxidative level. Regular exercise has been shown to benefit its practitioners and prevent and control diseases, such as melatonin level, breast cancer. Fitness qigong from Chinese tradition sport, characterized by simple, slow, and full-body exercise, is appropriate for the middle-age women population. Therefore, It is essential that effects of Fitness qigong on 6-hydroxymelatonin sulphate, metabolite of melatonin and sleep quality are observed in middle-age women in this study.
Methods
30 female volunteers participated Fitness qigong, Baduanjin exercise, whereas participants did not change their regular lifestyle. The study lasted 32 weeks, both before and after Baduanjin exercise program, urinary 6-hydroxymelatonin sulphate, the Chinese-version PSQI were assayed.The 6-hydroxymelatonin sulphate as melatonin levels were analyzed using an enzyme-linked immunosorbent assay (ELISA).
Results
After 32 weeks exercise, urinary 6-hydroxymelatonin sulphate increased from 144.350±14.479 ng/ml to 156.461±15.032 ng/ml（$P<0.05$）, It showed that melatonin was high regulated. Pittsburgh Sleep Quality Index (PSQI) total score decreased from 8.428±2.700 to 5.000±2.160（$P<0.05$）.Subject sleep quality decreased from 1.286±0.756 to 0.714±0.756（$P<0.05$）,sleep latency decreased from 1.285±0.951 to 0.571±0.787,sleep duration decreased from 1.714±0.488 to 0.714±0.756（$P<0.05$）,sleep efficiency decreased from1.429±0.535 to 0.429±0.535（$P<0.05$）,sleep disturbance ,daytime dysfunction, use of hypnotic were not different between before and after experiment.
Discussion
Melatonin is secreted during the dark hours at night by pineal gland, and it regulates a variety of important central and peripheral actions related to circadian rhythms and reproduction. Our results showed that women's 6-hydroxymelatonin sulphate increase by Fitness Qigong. Consequently sleep quality improved in Middle-age women. It is possible that the protective effect of exercise with respect to breast cancer may operate in part through an effect on melatonin.

EFFECTS OF OUTDOOR ACTIVITIES ON THE SENSE OF SPIRITUALITY EXAMINED FROM DIFFERENCES BETWEEN OUTDOOR ACTIVITIES AND COMPETITIVE SPORTS.

KIJI, M., KASE, T., NIGORIKAWA, T.

RIKKYO UNIVERSITY

Introduction
Many studies have shown that human's health and spirituality have close relations. Moreover, our previous study revealed that there would be certain relations between the habits of daily exercise and the tendency of spirituality. It was also shown that daily exercise might strengthen one's tendency of spirituality. On the other hand, several studies mentioned that staying in the natural field could enhance one's sense of spirituality. In this study differences in the effects on one's spiritual tendency between outdoor activities and competitive sports were examined.
Methods
The subjects of the study consisted of 29 male and 30 female university students (Mean age = 19.8). They were divided into two groups: the natural field camp group (NFCG; n = 30) and the competitive sports camp group (CSCG; n = 29). The NFCG consisted of students who took part in an outdoor activity camp, whereas students of the CSCG participated in a competitive sports camp. Both camps included activities over 5 days. The tendencies toward spirituality and health were measured using The Japanese Youth Spirituality Rating Scale (JYS), The Purpose In Life Test (PIL) and The Natural Health Questioner (GHQ) and then compared between the two groups.
Results
In regard to PIL, there was no significant difference between the NFCG and the CSCG before participating in the camp activities, but both groups showed higher scores of PIL afterwards. The NFCG showed higher scores of JYS than those of the CSCG before taking part in the camp activities. However, both groups showed higher scores of JYS after the camps, respectively. Regarding the GHQ, the NFCG showed lower scores of GHQ than those of the CSCG, which means that the NFCG were in a better condition of mental health than the CSCG.
Discussion
Our previous study suggested that there was a relationship between habits of daily exercise and the tendency of spirituality. This study aimed to examine which group (NFCG or CSCG) could enhance the tendency of spirituality more efficiently. As a result, it was revealed that outdoor activities could enhance one's tendency of spirituality more efficiently than ordinary competitive sports. Further investigation is demanded to clear what kind of mechanisms lead to this result.
Contact
e-mail : kiji@eco-plan.jp

FINDING ENVIRONMENTAL KNOWLEDGE IN SCUBA-BASED TEXTUAL MATERIALS

AYGUN, Y., GUNDOGDU, C., ILKIM, M.

UNIVERSITY OF INONU

Introduction
As marine environments within the adventure domain are the future key-settings in recreational SCUBA diving experience, SCUBA-based textual materials should provide insight into environmental knowledge that is well connected to the practitioners' behavior and attitude. The purpose of this study therefore, was to examine a major recreational SCUBA diver manual for novice divers from a position that seeks to understand scope of the environmental knowledge in semantic network (TSSF, 2014).
Methods
This research captures environmental aspects of the recreational SCUBA diver manual penned in partnership with Turkish Underwater Sports Federation (TSSF) and World Confederation of Underwater Activities (CMAS). To address the intellectual and theoretical contributions

of the study, we posed a developmental puzzle: what we can grasp from the textual materials focusing on the environmental knowledge, and how we can connect this with the novice SCUBA divers' environmental behavior and attitudes in a proper manner (Mason, 2002). Qualitative document analysis was applied through the recreational SCUBA diver manual for a better understanding about the social phenomenon.
Results
Statements and notes from the data have been presented according to the marine-based conservation and aquatic life sub-themes, within the predetermined context of environmental knowledge. Upon scanning data, we found that the scope of the recreational diver manual in the sense of marine-based conservation and aqutic life was skimp. For example, any amenable knowledge regarding underwater skill levels that strongly link to divers' environmental behavior and attitude was not found in the manual.
Discussion
In an effort to gain insight into the diver manual in the perspective of environmental knowledge, we captured that there was no skill-related knowledge which attributes to SCUBA divers' environmental behavior and attitude. However, existing research into environmental knowledge, behavior and attitude noted that each of these contexts are interrelated in terms of SCUBA divers (Fishman, 1991; Talge, 1992).
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Contact
(yalinaygun@gmail.com)

Mini-Orals

MO-BN3 Technology and methods

THE EFFECT OF CONTACT ANGLE ON VARYING ELECTRONIC BODY PROTECTOR IN SIDE KICKS

PENG, Y.C.1,2, CHANG, J.S.1, LIN, Y.C.1, TANG, W.T.1
1:GIACS-NTSU(TAOYUAN, TAIWAN), 2:PE-NCKU(TAINAN, TAIWAN)

Introduction
The official electronic body protector has been applied to Taekwondo since 2008 Peking Olympic game. However, the use of electronic body protector has been suggested to have important impacts on Taekwondo game as the electronic scoring system may significantly affect the strategy of attacking skill (Tasika, 2013). More specifically, the side kick has been shown to be able to effectively to contact the electronic body protector as compared to other kick skills. However, it remains unclear whether different brands of electronic body protector affect the induction values. Therefore, the aim of the present study was to investigate the differences in induction values associated with contact angle of side kick in electronic body protector from different brands (i.e., Daedo brand & KP & P brand) in Taekwondo.
Methods
Twelve male college athlete of division 1 Taekwondo team were recruited for the study. Subjects were precluded if they presented with cardiovascular, pulmonary, neurological or musculoskeletal disorders. The study protocol was approved by the human subjects ethics review subcommittee of the Fu Jen Catholic University, and all participants signed committee-approved informed consents. An eight-camera motion analysis system was used to collect the position of the reflective markers at a sampling rate of 240 Hz. Kinematics data during side kick of different angles were initially collected. SPSS statistical software (SPSS Inc., USA) was used in this study for statistics and analysis.
Results
The results revealed a significant difference in contact angle across different height of side kick ($p < .05$). However, such difference was observed selectively for the KP&P EBP ($p < .05$) but not for the Daedo EBP.
Discussion
Previous research observed that the real force of numerical and Electronic Body Protector measuring force is different, suggesting that the force sensor is non-linear through the location with vertical impact (Ramazanoglu, 2013). More than this, the present study revealed the influences of different EBP brands on induction values, with the evidence showing that Daedo EBP was less affected by contact angle, which may have more objective scoring by reducing the influence of individuals in body height.
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Contact
wentzutang@gmail.com

THE EFFECT OF SIDE KICKS ON DIFFERENT AREA OF ELECTRONIC BODY PROTECTOR

LIU, T.T., CHANG, J.S., LIN, Y.C., TANG, W.T.
TAMKANG UNIVERSITY, NATIONAL TAIWAN SPORT UNIVERSITY

Introduction
The World Taekwondo Federation (WTF) stipulated the utilization of electronic body protectors (EBPs) with embedded sensors in order to detect points electronically. The attacking skills and scoring strategy had been changed in the game. In the past emphasis on defensive use side kick that has become one of the means of scoring. Therefore, the aim of this study was to investigate the inductive value by side kicking in five different areas of EBP.
Methods

An EBP (KP&P) was used for the experiment. Twelve TKD male athletes were asked to adopt the same starting posture and perform the side kick three times in five different areas. Five 'hit' areas were defined and marked on the EBP. For comparison within three different height in the same impact area and detects the inductive value of EBP.
Results
The results revealed a significant difference in middle portion of the front of the EBP impact area and across different height of side kick.
Discussion
Although previous research suggest that the respective EBP does not present the necessary accuracy, reliability and linearity for the unit of measurement used for assessing a standardised hit [1]. In the present study, we detects the effect of induction values in different area of EBP (KP&P) , with the evidence showing that middle portion of the front of the EBP was higher inductive value across different height of side kick.
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Contact
wentzutang@gmail.com

VALIDITY AND RELIABILITY OF DELSYS TRIGNO WIRELESS SENSOR COMPARED TO 3-D MOTION CAPTURE SYSTEM WHEN DETECTING JOINT ANGLES

HO, H.Z., LEE, H.J.

NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction
The instant feedback system is a convenient way to record joint angles. Delsys Trigno Wireless sensor combined with the accelerometer, gyro, and inclinometer could calculate kinematics parameters of two linked segments. However, the reliability and validity of the sensor were unknown, we could not use the results to predict true joint angles. A 3-D motion capture system was widely used in movement analysis, and could be a standard to the parameter it examined (McGinley et al.,2009). Therefore, the purpose of this study was to test validity and reliability of Delsys wireless sensor compared to 3-D (VICON) motion capture system when detecting joint angles.
Methods
Eight healthy males (Age:23±2.3 yrs) were volunteered for this study. The dominant side of subjects was been examined. Delsys Wireless sensor and motion capture system both collected elbow and knee angles at 148 Hz. The participants were asked to perform active elbow flexion at 0, 30, 60, and 90 degrees, knee flexion at 45,60, and 90 degrees, and walked at self-selected speed for three trials. Test-retest reliability was conducted to get the intra-class correlation coefficient (ICC). Pearson correlation was conducted to detect the validity of these two systems.
Results
Good reliability was found for the Delsys sensor in elbow and knee joint angles. The ICC values for elbow flexion angle were 0.832 at 0 degrees, 0.957 at 30 degrees, 0.894 at 60 degrees, and 0.944 at 90 degrees, and for knee flexion angle were 0.515 at 45 degrees, 0.711 at 60 degrees, and 0.905 at 90 degrees. Pearson correlation coefficients between the Delsys and VICON systems were found significance when elbow flexion were 0.534 at 0 degrees, 0.592 at 30 degrees, 0.364 at 60 degrees, and 0.582 at 90 degrees. The knee was only found a significant correlation (0.878) at 45-degree flexion angles. There were no significant correlations found during walking trials.
Discussion
The benefit of using Delsys sensor was the instant feedback from the kinematics parameters. It also demonstrated good reliability to measure elbow and knee joint angles. But the validity of the Delsys sensor was only found significant on all elbow and less flexed knee angle at 45 degrees. The less robust validity could cause by different kinematics calculating methods on two linked segments, different location of the sensors and markers were placed. Greater joint motions could cause more motion artifacts which were directly associated with experimental variabilities. During walking trials, poor reliability and validity of the Delsys sensor were also oriented from motion artifacts of continues walking patterns (Chung, & Ng.,2012). In order to use the Delsys sensor as the joint kinematics measuring devices in the future, the validity on measuring greater joint angles and continuous movements should be emphasized and improved.
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Contact
hjlee@ntnu.edu.tw

AN ANALYSIS OF PERFORMING TIMES IN EVERYDAY LIFE MOVEMENTS THROUGHOUT LIFE

ESPINOSA-SANCHEZ, M.

NATIONAL UNIVERSITY OF MEXICO

Introduction
The movements of everyday life of individuals include walking, climbing up and down stairs, and sitting and standing up (Blanke & Hageman, 1989). Throughout life, individuals undergo major changes in body structure that depend on different factors. This study aims to know how throughout the life the individuals modify the execution of daily movements. The first phase of this study consists of analyzing the execution times in relation to the participants' preferred speed.
Methods
For the study, a system of 11 inertial sensors placed in the body of the participants was used. A movement sequence was established that consisted of walking 3 meters in a straight line, climbing three steps and sitting and standing on seat without arms. The stair and the seat were designed according to architectural and furniture standards. The participating sample covers 10 to 65 years and over. Execution times were extracted after identifying the stride sequences, going up and down one step, and sitting and standing. Statistical analysis was performed with IBM SPSS setting • = 0.05. The sample consisted of 56 women, mean: 27.79 ± 18.50 years, range: of 57.96 years, maximum/minimum values: 68.36/10.40 years; 53 men, mean: 28.12 ± 18.22 years, range of 62.49 years, maximum/minimum 72.92/10.44 years.
Results

The run times [s] recorded by the system SW were (women/men), of the first step: 0.67 ± 0.11 / 0.68 ± 0.1, second step: 0.64 ± 0.12 / 0.67 ± 0.11, step-up 1.3 ± 0.54 / 1.03 / 0.33, Step-down: 1.08 ± 0.37 / 0.93 ± 0.35, sit: 1.8 ± 0.44 / 1.72 ± 0.33, and stand up: 1.5 ± 0.37 / 1.49 ± 0.3.
To check if the data are normally distributed the Shapiro-Wilk test is used. The p-value of the test show that (women/men) age: 0.0/0.0, first step 0.147/0.369, second step 0.466/0.160, step-up 0.002/0.000, step-down 0.007/0.000, sit 0.001/0.321, stand up 0.003/0.055. The results indicate that the data do not form a normal distribution. To know if there are significant differences between women and men, the U de Mann-Whitney Test for two independent samples have been applied. The results indicated that the p-value for age: 0.966, first step 0.645, second step 0,283, step-up 0.050, step-down 0.044, sit 0.971, stand up 0.680.
Discussion
The trend lines of the data indicate that the stride time is shortened as people get older. The step-up time is almost constant for men, but women are faster as they get older. The step-down time, men are slightly slower as they grow and women are slower among younger. Sitting times are similar between men and women, although men are slower when they are older. The time to stand up, is even more similar between men and women, are slightly slower the older.
In this first approach of the movements performance of daily life have similarities in walking and in sitting and standing, not so in the going up and down stairs.
References
Blanke, D.J. y Hageman, P.A. 1989. Comparison of Gait of Young Men and Elderly Men. Physical Therapy, 69 (2).

INVESTIGATION MOVEMENT COORDINATION AND OUTCOME PERFORMANCE OF AIR PISTOL SHOOTING

CHEN, H.H., HSIEH, T.Y.
TAITUNG UNIVERSITY

Introduction
Pistol shooting is a skill that requires high level of fine interaction of visuomotor interaction that the control of movement of multiple segments is challenged by the system's sensitivity. The noise plays a substantial role in the formation of kinematic trajectory of aiming and shooting action. To understand the feature of movement coordination of pistol shooting skill, researchers suggested separate the deterministic components of postural control from that of random component of limbs tremor in data. However, few study has been examined the feature of coordination of movement from multiple segments in a pistol shooting. The purpose of this study was to investigate the movement coordination of pistol shooting using principal component analysis as the filter to process the data. In addition, the change of coordination was examined during the repeatedly shooting in competition.
Methods
Six air pistol shooters participated in the present study. During the simulated competition, the coordinates of three dimensions of markers attached on their major segments (e.g., shoulder, elbow, wrist, pistol) for shooting and the trajectory of aiming and the score of shooting of each trial were collected. We required participants to complete the shooting trials in a 75 (male)/50 (female)-min period. The principal component analysis (PCA) was used on signals of movement of shooting related segments and aiming point to examine the change of movement coordination. In addition, the relationship between movement coordination and shooting performance was examined.
Results
Four components explained almost 95% of the variance of the data. The major components contain all the segments and consist with the slow motion of drift when shooting. The characteristics of movement coordination of shooting were found in the residual components in the form of irregular and random. Patterns of coordination between successful and unsuccessful performance are similar. However, significant difference was found in the amplitude of change in distal segments in particular for residual components.
Discussion
The coordination pattern of shooting could be tease apart into deterministic and stochastic components of movement patterns by using PCA. The important features of pistol shooting performance were found in the stochastic part which correspondent to the motion of tremor of distal segment and gun.

16:15 - 17:45

Invited symposia

IS-PM06 FASCIA - AN EXTENSIVELY OVERLOOKED TISSUE

FASCIAE - THE FORGOTTEN TISSUE

STECCO, C.
UNIVERSITY OF PADOVA

It is commonly thought that everything that is to be known about the human anatomy has already been revealed, however, if we consider fascial anatomy, nothing is more far from the truth. For many years, the fasciae have been considered only as a "white envelope for the muscles", and very little attention has been given to their macroscopic and histological anatomy. It is probably for this reason that different descriptions of the fasciae exist in Literature and different terms are presently used to define the same structure. Only the definition of a precise and unambiguous terminology will permit the correct diffusion of new knowledge concerning the fasciae.
The presentation will illustrate new studies of the gross and histological (fibre content, structural conformation, and innervation) anatomy of the human fasciae, and debate their role in proprioception.
In particular we'll try to answers to some questions concerning fascial anatomy:
- Deep muscular fascia is a dense, regular connective tissue similar to an aponeurosis, as suggested by some Authors, or it is an irregular loose connective tissue?
- Inside the deep fasciae can we recognize different regular sublayers, or are the fasciae composed of intertwined bundles of collagen fibres?
- How are the deep fasciae related with the underlying muscles?

- Does the superficial fascia exist? Does it have a specific structure, or not?
- How do the various fasciae appear under ultrasound, MRI, and CAT scans? Could these instruments help us to understand the structure of the fasciae in living
people? And what about the relationship between fasciae and surrounding structures?
- What is the role of the extracellular matrix, and in particular of the hyaluronic acid component?
- Could fasciae be considered elastic tissue? What is the percentage of elastic fibres within fasciae? Are there regional variations?
- Are fasciae innervated? And what type of receptors could be recognized within fasciae?
- What is the relationship between the fasciae and muscle spindles?
- Do the fasciae possess a basal tonus?
- Do fasciae have the capacity to actively contract?
- Do fasciae have a role in proprioception and in peripheral motor coordination?

Answers to these questions could contribute understanding of the biomechanical behaviour of the fasciae, their role in acute and chronic myofascial pain syndromes and of the real effectiveness of different trainings.

THE IMPACT OF NUTRITION ON THE FASCIAL SYSTEM

OESSER, S.

COLLAGEN RESEARCH INSTITUTE

Fascial tissues, such as intramuscular connective tissue, tendons, ligaments and joint capsules play an important role in the maintenance of mobility. It is well known that sport, specific exercise, and everyday physical activity influence the turnover of fascial tissues, but the impact nutrition can have on a healthy fascia system is increasingly a subject of considerable interest. Connective tissue cells play an essential role in the remodeling of the extracellular matrix (ECM), which is for example required in the initial phase of a training period, when matrix turnover is increased.

It has already been demonstrated that sufficient amounts of functional amino acids such as glycine, proline, arginine and alanine are needed as building blocks to maintain the structural integrity of the ECM. In addition, there is evidence that peptides can directly influence the connective tissue cell metabolism. Very recent investigations and clinical trials have successfully demonstrated the efficacy of specific bioactive collagen peptides on the maintenance of connective tissue. The data suggests that collagen peptide supplementation markedly improves ECM synthesis, and could pay a role in injury prevention. Moreover, the intake of specific collagen peptides had a clear positive impact on the mechanical properties of ligaments and tendons, and it was shown that functional ankle stability could be improved in athletes suffering from chronical instability of this joint.

Although an increasing number of investigations clearly demonstrate the vital role nutrition - and particularly specific collagen peptides - play in fascia tissue integrity and function, further research is required to elucidate the mode of action, and subsequently provide optimized nutrition that can help improve dysfunctions and lessen pain.

THE EFFECTS AND POTENTIAL MECHANISMS OF FOAM ROLLING ON ATHLETIC PERFORMANCE

BEHM, D.

MEMORIAL UNIVERSITY OF NEWFOUNDLAND

Foam rolling is a relatively recent and popular technique that has been used as a component of a warm-up and cool down prior to and following competition and training as well as a tool to reduce myofascial-related pain. These rollers are often classified as "self-myofascial release" devices that could aid in reducing fascial restrictions and pain. Rolling has been reported to reduce the pain associated with delayed onset muscle soreness, muscle tender spots and high frequency electrically evoked tetanic muscle stimulation. However, there are a number of studies that demonstrate that myofascial pain can be attenuated not only by rolling the affected muscle but also by rolling the contralateral limb. Hence, these findings illustrate that a central neural component must play a significant role in pain inhibition. Rolling has also been shown to acutely increase range of motion (ROM). In contrast to prolonged static stretching, foam rolling does not impair subsequent performance and can in some studies actually improve neuromuscular efficiency and other performance measures. A recent report indicates that higher intensities or pressures of rolling do not augment the improvements in ROM. Durations of rolling of 5-10s have increased ROM but it seems that longer durations of 30-60s increase ROM to a greater degree. Intermittent rolling after static stretching has been shown to maintain ROM gains to a significantly greater degree than a single session of stretching with or without rolling. The mechanism underlying the rolling-induced increases in ROM have not been fully established but may be related to thixotropic factors, reflex neural inhibition and increased stretch tolerance.

Invited symposia

IS-EX03 ACSM-ECSS EXCHANGE SYMPOSIUM: THE COMPELLING LINK BETWEEN PHYSICAL ACTIVITY AND YOUR BODYS DEFENSE SYSTEM

PRACTICAL STRATEGIES TO AVOID IMMUNE IMPAIRMENT IN THE ENDURANCE ATHLETE AND WARFIGHTER

WALSH, N.

BANGOR UNIVERSITY

It is widely believed that endurance athletes, and those in physically and psychologically demanding occupations (e.g. warfighter), are at an increased risk of suffering upper respiratory tract infections (URTIs). As logic dictates, a high training volume is incompatible with frequent URTIs viz. 'the less sick, the more the athlete or warfighter can train'. Emerging empirical evidence indicates that successful athletes who make it to international level, and those who win international medals, suffer fewer and shorter lasting URTIs than less successful athletes. A strong body of evidence shows that a bout of heavy exercise (typically >1.5 h duration) and a period of heavy training bring about a temporary decrease in immune function; typically lasting less than 24 hours. The temporary lowering of immune function after heavy exercise may serve a protective role by reducing the short-term inflammatory effects of exercise. Paradoxically, the penalty of this anti-inflammatory effect of heavy exercise is the reduced ability to mount anti-viral effector responses; potentially allowing pathogens to gain a foothold. As such, it is important that the endurance athlete and warfighter avoid a chronic disturbance in immune

function to reduce the risk of URTIs; and the associated impairments to training, competition and health. This lecture will cover countermeasures to immune impairment due to: training stress; life stress; poor sleep; environmental stress; travel and poor nutrition.

THE IMMUNE SYSTEM DOES ITS JOB BETTER WITH EXERCISE

NIEMAN, D.

APPALACHIAN STATE UNIVERSITY, NORTH CAROLINA

This lecture will provide an overview of early research in the area of exercise immunology, important research discoveries, and where the field is headed in the future. Although some studies on the immune response to exercise were first published more than a century ago, the modern phase of research began in the 1980s, coinciding with the discovery of HIV in 1983. Key findings on the exercise-immune-infection connection include: 1) Physically active people experience 40-50% fewer days with acute respiratory illnesses (ARI); 2) Acute, moderate exercise has its greatest effects on the innate immune system improving immunosurveillance against pathogens; 3) Chronic inflammation is very low in physically fit, lean individuals, a key benefit because of its connection to chronic disease; 4) Physically fit elderly individuals have immune systems that function at levels found in younger women; 5) Prolonged and vigorous exercise increases ARI incidence rates due to a transient downturn in immune function; 6) Cytokines involved in the acute inflammatory response to heavy exertion are produced by cells within muscle tissue, and carbohydrate intake attenuates the overall magnitude of increase; 7) In general, the relationship between exercise and ARI can be modeled in the form of a 'J' curve. The future of exercise immunology will be in the application of these principles to improving our understanding of immune involvement in mediating physical activity benefits in clinical populations.

Oral presentations

OP-PM49 Molecular Biology 1

ELASTIC BAND RESISTANCE TRAINING INDUCES EXTRACELLULAR MATRIX GENES IN SKELETAL MUSCLE OF OLDER FEMALES AS EVALUATED BY RNA SEQUENCING

WESSNER, B., TOSEVSKA, A., HOFMANN, M., FRANZKE, B., SCHOBER-HALPER, B., OESEN, S., TSCHAN, H., STRASSER, E.M., WAGNER, K.H.

UNIVERSITY OF VIENNA

Introduction
Human skeletal muscle is a highly plastic tissue that readily adapts to different environmental stimuli such as endurance and resistance training [1,2]. Within the Vienna Active Ageing Study (VAAS) we have shown that elastic band resistance training is able to improve functional performance and muscle quality of older adults [3,4]. However, the underlying molecular mechanisms in skeletal muscle inducing these benefits are still not thoroughly investigated. Therefore, this follow-up study aimed to investigate the muscular gene expression in response to resistance training with or without protein supplementation using RNA sequencing.
Methods
In total 104 females took part in the VAAS randomly assigned to one of the three intervention groups [cognitive training (CT), resistance training (RT), resistance training plus protein supplement (RTS, FortiFit®, Nutricia)]. We were able to obtain resting muscle biopsies pre and 6 months post intervention from 22 females aged 65 to 97 years. Total RNA was extracted from muscle tissue with the miRNeasy kit. Libraries were prepared using a NEBNext® Ultra™ Directional RNA Library Prep Kit and the samples were sequenced using HiSeq 3000/4000 generating paired-end reads. The aligned reads were counted using HTSeq count to obtain raw counts per gene before analyzing differential expression using DESeq2.
Results
Thirty-seven genes were were differentially expressed ($q<0.05$) between pre and 6 months post intervention, after correction for batch and age effects. Closer analyses revealed that the observed changes occurred only in the RT group, but not in the CT group or RTS group. Pathway analyses with ConsensusPathDB detected a significant enrichment of pathways with reference to the extracellular matrix (ECM) such as ECM organization, ECM proteoglycans, focal adhesion, syndecan interactions, non-integrin membrane ECM interactions and TGF-beta signaling) which were confirmed by standard quantitative real-time PCR (all $p<0.05$ for ANOVA).
Discussion
Our data revealed that resistance training was able to induce ECM genes and especially the TGF-beta pathway. There is evidence that the muscular ECM plays an important role in contractile force production [5] which is impaired with ageing [6]. Therefore, our study provides first evidence that improvements in functional performance induced by resistance training in elderly are associated with ECM remodeling.
References
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Contact
barbara.wessner@univie.ac.at

THE EFFECT OF LIFE-LONG SPORT ON MICRORNA EXPRESSION PATTERN IN HUMAN SKELETAL MUSCLE

BORI, Z.1, KOLTAI, E.1, RADAK, Z.

UNIVERSITY OF PHYSICAL EDUCATION

Introduction

MicroRNA (miRNA) a class of noncoding RNA are involved in gene expression. These very small RNAs of approximately 23 nucleotides regulate gene expression by a posttranscriptional mechanism. It is estimated that more than 60% of all human protein-coding mRNA contain one or more miRNA target sites within their 3'-untranslated region (UTR) suggesting that miRNA are involved in most developmental and cellular processes. Based on this our laboratory examined the effect of life-long exercise on miRNA expression pattern in human skeletal muscle in aged individuals.
Methods
We recruited master athletes at European Veterans Athletics Championships (Nyíregyháza, Hungary), and control partcipants at nursing home (Györ, Hungary). Subjects older than 65 years were included in this study. The study was approved by the ethical committee of Semmelweis University (Budapest, Hungary). All participants had given written informed consent before inclusion. Muscle biopsy samples were taken from vastus lateralis. MicroRNA microarray a high throughput method for studying microRNA expression was performed on muscle RNA samples of four master athletes and four control patients using Agilent Human miRNA array chip and Agilent Scanner. The quantitative real-time PCR analyses were performed on an Applied Biosystems thermal cycler instrument using TaqMan MicroRNA assay kits. Reported values were normalized to the average values of the internal standards (housekeeping miRNA). Statistical significance was assessed by ANOVA. The significance level was set at $p = 0.05$ (Statistica ver. 12.).
Results
In the microRNA array analysis relatively very small portion, only about two dozens of miRNA in the whole human miRNA pool shows difference in their expression levels in master athletes and sedentary skeletal muscles ($p<0.035$). Among them miR-206, which is a member of MyomiR family expressed specifically in skeletal muscle. To confirm microarray results four miRNAs were chosen for further analysis: miR-7, -125b, -193b, -206. In the quantitative Real-Time PCR analysis only one of them retained its significant difference: miR-7 expression level of sedentary skeletal samples was just half that of master athletes samples ($p=0.05$).
Discussion
In our study the difference in the level of miRNA expressed in human skeletal muscle between master athletes and sedentary control samples was relatively very small: only about 2% of the whole miRNA pool shows significant difference in miRNA microarray analysis. By the help of quantitative Real-Time PCR we could confirm only one significant alteration in the microRNA pool. Our results suggest that life-long sport has no great impact on microRNA expression pattern of human skeletal muscle. This phenomenon may reflect the basic function of microRNA: regulation of gene expression by posttrancriptional mechanism is not the key mechanism by which exercise modulates aged skeletal muscle.
Contact
bori.zoltan@tf.hu

WHY CHANGES IN MRNA CONTENT MIGHT GIVE LIMITED INSIGHTS INTO ADAPTATIONS TO EXERCISE

BISHOP, D., MCGINLEY, C., GRANATA, C., YAN, X., KUANG, J., EYNON, N.

VICTORIA UNIVERSITY

Introduction
Despite the dominant role of transcription in determining protein abundance [1], there are important gaps in our understanding of the transcriptional response to exercise. A limitation of most studies is they only investigate changes in gene expression at convenient, and arguably arbitrary, time points (often 2 to 5 h post exercise)[2]. Furthermore, while it is often stated that adaptations to training are the result of the cumulative effects of transient changes in gene expression after each exercise session [3], it is rare to find exercise studies where changes in both mRNA and protein content have been measured within the same study. The aim of this study was a) to describe the kinetics for exercise-induced changes in mRNA content of genes related to mitochondrial biogenesis, and b) to investigate the relationship between these changes and the subsequent changes in mitochondrial protein content.
Methods
For study A, 16 men performed a single session of High-Intensity Interval Exercise (HIIE) (7 × 2 min at ~ 80% VO2max). Muscle biopsies were taken immediately post-exercise (0 h), and 3, 9, 24, 48 and 72 h post-exercise. Exercise-induced changes in the mRNA content of genes related to mitochondrial biogenesis were measured with qPCR. For study B, 30 active men performed the same single session of HIIE as in study A, followed by 4 weeks of high-intensity interval training (HIIT)[4]. Muscle biopsies were taken before, and 0 and 3 h post HIIE, and assessed for exercise-induced changes in mRNA content of genes related to mitochondrial biogenesis. A muscle biopsy was also taken after the last training session, and, along with the pre-training muscle sample, assessed for citrate synthase (CS) activity, the content of mitochondrial proteins (western blot), and mitochondrial respiration (Oroborus).
Results
Study A. Peak changes in genes related to mitochondrial biogenesis (e.g., PGC-1a, PPARa, CS, TFAM, p53) occurred from 3 to 48 h post exercise. Study B. There were no significant correlations between exercise-induced changes in genes and training-induced changes in the corresponding protein or training-induced changes in CS activity or mitochondrial respiration.
Discussion
These data highlight that the timing of a single endpoint biopsy can influence conclusions made about the transcriptional response to a single exercise session. However, even when our biopsy timing corresponded with peak changes in genes of interest, we did not find a significant relationship between exercise-induced changes in mitochondrial genes and subsequent training-induced mitochondrial adaptations. These data highlight limitations associated with the use of exercise-induced changes in mRNA content to understand the molecular response to exercise and training.
References
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THE BASAL EXPRESSION OF GENES AND PROTEINS INVOLVED IN ADAPTATION TO AEROBIC TRAINING IN HUMAN SKELETAL MUSCLE

POPOV, D.V.1,2, LYSENKO, E.A.1,2, BUTKOV, A.D., KUROCHKINA, N.S.1, VOLODINA, M.A.3, VYSOKIKH, M.Y.2,3, VINOGRADOVA, O.L.1,2

1: SSC RF INSTITUTE OF BIOMEDICAL PROBLEMS RAS, 2: M.V. LOMONOSOV MOSCOW STATE UNIVERSITY, 3: RESEARCH CENTER FOR OBSTETRICS, GYNECOLOGY AND PERINATOLOGY

Introduction
Endurance exercise activates molecular mechanisms regulating mitochondrial biogenesis in skeletal muscle. Molecular responses to acute endurance exercise in human skeletal muscle were investigated intensively during the last decade. However, only a few works investigated training-induced changes in basal expression of genes and protein involved in regulation of mitochondrial biogenesis. The study investigated the basal expression of genes and proteins related to adaptation to aerobic training in human skeletal muscle.
Methods
Ten untrained males were involved in 8 week cycling training (1 h x 5/wk). Whole body aerobic performance and aerobic performance of the knee extensors were evaluated using the incremental cycling and one-legged knee extension tests, accordingly. Basal biopsy samples from vastus lateralis muscle were taken before and after the training. Mass-specific oxygen flux in permeabilized muscle fibres was detected by high-resolution respirometry. Phosphorylation level and content of signal proteins were determined by Western blotting, gene expression was measured by qPCR.
Results
The training induced an increase in whole body aerobic performance (38%) and in aerobic performance of knee extensor muscles (17%) as well as in ADP-stimulated respiration and content of mitochondrial proteins. These changes were shown to be linked to an increase in the basal phosphorylation levels of CaMKII_Thr286, transcription factors CREB1_Ser133 and FOXO1_Ser256, as well as the basal content of CREB-regulated transcription coactivator 2(CRTC2) and transcription factors NR4A3 and TFAM. Training-induced activation of mitochondrial biogenesis did not depend on the basal activation of AMPK and mitogen activated signaling pathways (p38 and ERK1/2) as well as on the basal PGC-1α protein content and PGC-1α gene expression via the canonical and alternative promoters.
Discussion
Our work and other studies showed that activation of mitochondrial biogenesis in muscle induced by aerobic training involves both a transient increase in expression of genes and activation of signalling proteins induced by acute exercise and an increase in the basal expression of genes and proteins involved in regulation of mitochondrial biogenesis.
Contact
danil-popov@yandex.ru

SEX-BASED DIFFERENCES IN SKELETAL MUSCLE FIBER COMPOSITION AND THE ROLE OF GENETIC POLYMORPHISMS

KUMAGAI, H.1, TOBINA, T.2, SEKINE-ICHINOSEKI, N.1, KAKIGI, R.1, TSUZUKI, T.1, ZEMPO, H.1, SHIOSE, K.3, YOSHIMURA, E.4, KUMAHARA, H.5, AYABE, M.6, HIGAKI, Y.7, KOBAYASHI, H.8, KIYONAGA, A.7, NAITO, H.1

1 JUNTENDO UNIV, 2 UNIV OF NAGASAKI, 3 JAPANS INSTITUTE OF SPORTS SCIENCE, 4 KUMAMOTO PREFECTURAL UNIV, 5 NAKAMURA GAKUEN UNIV, 6 OKAYAMA PREFECTURAL UNIV, 7 FUKUOKA UNIV, 8 TSUKUBA UNIV HOSPITAL

Introduction
The heritability of human skeletal muscle fiber composition is estimated to be approximately 45.0-99.5%. Although previous studies have shown that genetic polymorphisms (e.g., ACTN3 R577X, ACE I/D, and AGTR2 A/C) and sex influence muscle fiber composition, these findings are inconclusive. Thus, in the present study, we aimed to examine the effects of genetic polymorphisms on muscle fiber composition with respect to sex-based differences in the general Japanese population.
Methods
In total, 188 healthy Japanese individuals (95 males and 93 females), aged 20-79 years, participated in the present study. Muscle biopsies were taken from the vastus lateralis, and levels of myosin-heavy chain isoforms (Type I, IIa, and IIx) were determined by use of SDS-PAGE. ACTN3 R577X (rs1815739), ACE I/D (rs4340), and AGTR2 (rs11091046) polymorphisms were determined by use of TaqMan SNP Genotyping Assays.
Results
The male and female subjects did not significantly differ in age. The proportion of the type I isoform was significantly lower in males than in females (41.3 ± 1.2 vs. 51.1 ± 1.2%, $p < 0.001$), while the proportions of type IIa (35.2 ± 0.8 vs. 30.4 ± 0.9%, $p < 0.001$) and type IIx (23.6 ± 1.0 vs. 18.5 ± 0.9%, $p < 0.001$) isoforms were significantly higher in males than in females. The proportions of type I and type IIa isoforms were significantly correlated with age only in male ($r = 0.35$, $p < 0.001$; $r = -0.30$, $p = 0.004$; respectively), but not in female. All polymorphisms were within Hardy-Weinberg equilibrium. Male with the ACTN3 RR+RX genotype exhibited a significantly higher proportion of the type IIx isoform than did those with the ACTN3 XX genotype (25.0 ± 1.1 vs. 20.0 ± 1.6 %, $p < 0.05$). This trend with respect to proportion of type IIx isoform in males with ACTN3 R577X was similar even after adjusting for age as a covariant ($p < 0.05$). In both males and females, no significant associations were found between muscle fiber composition and ACE I/D or AGTR2 A/C polymorphisms.
Discussion
We found distinct sex-based differences in muscle fiber composition. The ACTN3 R577X polymorphism was partially associated with muscle fiber composition in males. Further extensive studies are necessary to determine the genetic factors that influence muscle fiber composition, especially in females.
Contact
kumazin7@gmail.com

MOLECULAR RESPONSE TO STRENGTH EXERCISE IN HUMAN SKELETAL MUSCLE: EFFECTS OF FITNESS LEVEL AND MUSCLE FIBER COMPOSITION

LYSENKO, E.A., POPOV, D.V., VEPKHVADZE, T.F., VINOGRADOVA, O.L.

SSC RF INSTITUTE OF BIOMEDICAL PROBLEMS RAS

Introduction

Strength exercise has been shown to activate signaling cascades regulating protein translation in skeletal muscles. However, molecular mechanisms of adaptation of skeletal muscle (especially for muscle adapted to strength training) to strength training are not clearly understood. In the present work we compared molecular response to acute strength exercise in skeletal muscle of well-trained strength athletes and untrained individuals.
Methods
Eight healthy recreationally active males and eight well-trained competitive powerlifters performed 5 sets of leg press with 65% of 1RM load to failure. Before exercise session, 1 and 5 h after it biopsies from m. vastus lateralis were taken.
Results
The exercise session did not induce significant increase in p70S6K(Thr389) and 4E-BP1(Thr37/46) phosphorylation, markers of mTORC1 activation, in both groups. Whereas phosphorylation level of eEF2(Thr56) was decreased and phosphorylation level of ACC(Ser79), a marker of AMPK activity, was increased only in trained group. The expression of MHCIIA was significantly higher in trained compared with untrained group. All participants were divided in two groups: with low and high expression of MHCIIA. The group with high expression of MHCIIA demonstrated significant increase in the phosphorylation levels of p70S6K(Thr389) and ACC(Ser79) after the exercise.
Discussions
We did not observe activation of mTORC1 in both groups. For untrained group it might be partially explained by less involvement of muscle fibers during the exercise (untrained group exhibited lower specific force). This assumption is supported by absence of an increase in phosphorylation level of AMPK substrate ACC(Ser79) and absence of a decrease in phosphorylation level of eEF2(Thr56) in untrained group. Furthermore we observed significant difference between the groups in MHCIIA content. It has been shown that slow and fast muscle fibers demonstrate significantly different response to strength exercise (Koopman et al., 2006; Tannerstedt et al., 2009). Therefore, we divided the participants in two groups with low and high expression of MHCIIA. As expected, the increases in p70S6K(Thr389) and ACC(Ser79) phosphorylation were observed in muscles with high expression of MHCIIA. Therefore absence of mTORC1 activation in trained and untrained groups might be the consequence of distribution of the participants with high level of MHCIIA in the groups.
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Contact
e.a.lysenko@gmail.com

Invited symposia

IS-BN05 VARIABILITY AND COORDINATION IN HUMAN MOVEMENT

MOTOR CONSTRAINTS AND FUNCTIONAL VARIABILITY

MÜLLER, E., BUCHECKER, M., BIRKLBAUER, J.
UNIVERSITY OF SALZBURG

Introduction
Modern motor learning theories consider movement variability as an essential factor for delevoping healthy and/or highly functional control strategies. According to Bernstein (1967), movement results from forces generated directly by muscle activities and reactive phenomena such as gravitation, inertia or forces stored in muscle-tendon units. Hence, through an external manipulation of those reactive phenomena during physical activities, the system's overall bandwidth of experiences on how to adequately adapt to stimuli and/or stresses of an ever-changing environment should increase (Stergiou & Decker 2011). Experts consequently suggest to apply goal-orientated perturbations, so-called motor constraints, within training settings in order to provide patients/athletes with the opportunity to autonomoulsy scrutinize different neuromuscular impulses for achieving an optimal movement outcome (Hamill et al. 2012; Stergiou & Decker 2011).
Methods
In recent years, our working group conducted various studies which examined the effects of such motor constraints by analyzing, for example, the influence of elastic tubes attached to the hip and ankles on joint coordination variability in running (Haudum et al., 2014) or by testing measures related to the magnitude and structure of variability when using unstable compared to normal footwear while standing and walking (Buchecker et al., 2017; Stöggl & Müller 2012; Stöggl et al., 2010).
Results
All of the obtained results have in common that for the purpose of overcoming the increased demands in task space, the controller was forced to transit to a new, previously explored and evaluated state of system organization.
Discussion
Therefore, the used motor constraints within these aforementioned experiments can be expected to promote motor development by strengthening the interconnection among the various system elements.
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EXAMINING MOVEMENT COORDINATION AND IT'S VARIABILITY TO UNDERSTAND PATHOLOGICAL GAIT.

BOYER, K.

UNIVERSITY OF MASSACHUSETTS - AMHERST

Gait requires the integration of a complex control system, feedback loops, and other sensory regulatory mechanisms to permit the coordination of a redundant number of degrees of freedom in the musculo-skeletal system. With joint injury or pathology we expect that there will be a change in the movement coordination (i.e. relative magnitude and timing of joint kinematics) compared with a young healthy population. A change in the coordination of movement may alter the efficiency of movement, increasing the relative effort of lower extremity muscles and reducing the movement quality and variability as well as the capacity of an older or impaired individual to complete a movement task. Using both principal component analyses and vector coding approaches we have examined the impact of age, joint pathology and fatigue on movement coordination and its variability. With greater age and joint pathology, we have found increasing deviations in movement coordination and decreases in the coordination variability. These differences can be exacerbated a bout of moderate intensity activity. These results provide initial support for our hypothesis that alterations in movement and muscle coordination in gait may be an important limiting factor in physical performance. Understanding these changes is critical as clinical outcomes may be affected by alterations in the coordination of movement which will dictate the dynamic loads acting on the lower extremity joints.

BALANCE AND COORDINATION

FEDEROLF, P.

UNIVERSITY OF INNSBRUCK

Introduction
Human movement and how human movement is controlled by the sensorimotor system is highly variable, highly subject and highly task specific.
Methods
This talk will argue that analysing the coordination structure of kinematic marker data through a principal component analysis (PCA) offers a new approach to studying not only the biomechanics, but also the control of human movement.
Results
The PCA defines a coordinate system adapted to the solution space for a given movement task within the vector space of body postures. An increasing number of studies have used this approach in recent years to analyse and compare movement patterns between athletes, e.g. in karate, race walking, juggling, skiing and several other sports. Furthermore, by calculating velocities and accelerations in posture space, one obtains variables directly quantifying the control of postural movements (i.e. the resultant output of the neuromuscular motor control system).
Discussion
This facilitates the investigation of qualitative differences in the control of movement, e.g. by comparing the dominant and non-dominant limb or by investigating the effects of balance training.

Oral presentations

OP-PM28 Physiology and training in cycling

A COMPARISON OF MODELS TO QUANTIFY TRAINING LOAD IN CYCLING

JAVALOYES, A.

UNIVERSIDAD MIGUEL HERNANDEZ

Introduction
Quantification models aim to analyze the response to training, adaptive control process and make effective the training and recovery, especially in sports with high training volumes, such as road cycling. The aim of this study was to explore the sensitivity to the training process of four models to calculate training load scores in road cycling (a new whole body bioenergetics TRIMP, the Banister TRIMP, the session RPE model and Training Stress Score (TSS)) in road cyclist and their relationship with changes in heart rate variability.
Methods
After three weeks of familiarization with procedures and performed test to determining VO2max, critical power (CP), anaerobic work capacity (AWC) and Maximal Power Output (Pmax), 12 well-trained road cyclist performed 8 weeks of homogenous individual training to record their individual training data (duration, heart rate, power output and rate of perceived effort (RPE)) perceived recovery status.
Results
Very large correlation was obtained between Hayes & Quinn's TRIMP and RPE session ($r = 0.90$; $p < 0.001$) and TSS ($r = 0.88$; $p < 0.01$) and moderate correlation with Banister's TRIMP ($r = 0.64$; $p < 0.05$). Complete results are presented in table 1.
Conclusion
In accordance with these findings, Hayes & Quinn´s TRIMP is a promising mathematical model based on an individual bioenergetics' profile that could be used to quantify training load in road cycling. This research extends our knowledge about training load models that use power output to measure intensity.

EFFECTS OF RESISTANCE TRAINING FREQUENCY ON CYCLING ECONOMY IN OLDER MEN

SCHUMANN, M.1, FERNÁNDEZ-LEZAUN, E.2, MÄKINEN, T.3, KYRÖLÄINEN, H.2, WALKER, S.2

1 GERMAN SPORT UNIVERSITY, COLOGNE; 2 NEUROMUSCULAR RESEARCH CENTER, UNIVERSITY OF JYVÄSKYLÄ, FINLAND; 3 LIKES-RESEARCH CENTER FOR SPORT AND HEALTH SCIENCES, JYVÄSKYLÄ, FINLAND

Introduction
Resistance training (RT) increases strength and muscle mass in older individuals but also improves maximal aerobic capacity (1). However, measuring submaximal oxygen consumption (VO2) may better represent potential challenges in performing activities of daily living in older populations. This study aimed to determine the effects of training frequency during 9 months RT on VO2 in older men.

Methods
Forty men (70±3 years, 175±5 cm, 87±3 kg) were randomized into four groups, training none (C=11), one (G1=11), two (G2=7) or three (G3=11) times weekly. During months 1-3, all subjects trained twice-a-week with medium loads (14-20 rep., 40-60%1RM). Thereafter, training frequency was set according to the group, focusing on the development of maximal strength and muscle mass (4-12 rep., 60-90%1RM) and power in the last month (6-8 rep., 30-80%1RM). VO2 was measured during a cycling ergometer test at 50W, 75W and 100W. Maximal strength was measured by a 1-RM leg press test.
Results
Most decreases in VO2 occurred in all groups during months 1-3 (50W, G1 only: -15±7%, $p<0.001$, 75W and 100W: -9±6 to -15±11%, $p<0.05$). However, changes were also observed in C at all three increments (-9±4% to -13±5%, $p<0.001$). During months 4-9, reductions were only observed in G3 at 75W (-4±4%, $p<0.05$). Effect sizes for the change in VO2 during months 4-9 indicated a dose-response pattern, such that G1 showed no difference, G2 showed a moderate difference ($g=-0.58$, $p>0.05$) and G3 a large difference ($g=-0.89$, $p<0.05$) compared to C at 75W. A similar, pattern was observed for 100W (G2: $g=-0.59$; G3: $g=-0.68$; both $p>0.05$). In all training groups, baseline VO2 was associated with the individual changes during months 1-3 at 75W ($r=-0.5$, $p<0.01$) and 100W ($r=-0.49$, $p<0.05$). 1-RM increased at month 3 in G1 and G3 (11±5% and 8±4%, $p<0.001$), while further increases at month 9 only occurred in G3 (8±6%, $p<0.01$). No changes occurred in G2 and C.
Conclusion
This study showed that improvements in VO2 were pronounced during the initial 3-month of training and indicated a dose-response pattern during the subsequent 6 months, as previously observed with strength gains (2). As G2 also improved economy at month 3 but not strength, it is likely that the observed changes in VO2 originated from cardiorespiratory rather than neuromuscular adaptations. Furthermore, the observed correlation between initial VO2 values and its change in months 1-3, along with the dose-response improvements in months 4-9 highlight the importance of individual RT prescriptions.
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EFFECT OF CADENCE ON INTRACORTICAL INHIBITION AND FACILITATION DURING SUBMAXIMAL CYCLING

LAUBER, B., LICHTWARK, G., SIDHU, S., GOLLHOFER, A.

UNIVERSITY FREIBURG

Introduction
Unlike other rhythmic motor tasks, in cycling our preferred movement speed is not that which minimizes energy consumption. The reason for this is well understood but it might be that neural mechanism contribute to this phenomenon. Indirect evidence suggests that rhythmical locomotor outputs such as cycling are mediated by spinal centers but that supraspinal input is also required (e.g. Forman et al. 2015). While it is known that cadence can influence the processing of sensory information in the brain, it is unclear what effects changes in cadence can have on the output of the motor system. Thus, the aim of the present study was to investigate the inhibitory and facilatory output of the motor cortex during cycling at different cadences.
Methods
Fourteen participants cycled at 125W at a freely chosen cadence and at fixed cadences of 70, 80, 90 and 100 repeats per minute (rpm) during which transcranial magnetic stimulation (TMS) was used to measure short interval intracortical inhibition (SICI) and intracortical facilitation (ICF) at 50% of quadriceps electromyography activity in the downstroke phase. Two TMS protocols where applied and both involved a subthreshold stimulation followed by a suprathreshold stimulation with and interstimulus interval of 2.5ms (SICI) and 10ms (ICF). SICI and ICF were quantified by differences in peak to peak amplitude of the motor evoked potential (MEP) evoked during paired pulse stimulation compared to the MEP evoked by single pulse TMS.
Results
Planned comparisons revealed significant increased levels of intracortical inhibition (expressed as percentage difference to the single pulse MEP) while cycling at 70 (-16.1 6.3%, p= 0.05), 80 (-24.2 5.1%, p = 0.01) and 90 rpm (-12.2 6.2%, p = 0.03), while cycling at 100rpm and at the free chosen cadence was not different. Intracortical facilitation was significantly higher in the freely-chosen cadence (+13.4 5.9%, p = 0.05) but not during cycling at any of the fixed cadences.
Discussion
The results suggest that cycling at a cadence other than the preferred cadence results in increased levels of intracortical inhibition while cycling at the preferred cadence results in an increased intracortical facilitation. SICI is known to solely cause activation of inhibitory neurons in the motor cortex without directly affecting spinal circuitry (Di Lazzaro 2005) and therefore our results support the proposal that rhythmical motor patterns such as cycling have a central neural control mechanism (Zehr 2005) which is influenced by cadence.
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THE EFFECTS OF POWER OUTPUT ON JOINT MOMENT VARIABILITY AND SYNERGY IN WORLD CLASS FEMALE PURSUIT CYCLISTS

WHEAT, J.S., BURNIE, L., BARRATT, P.R.

SHEFFIELD HALLAM UNIVERSITY

Introduction
Successful team pursuit cycling requires a relatively constant team speed, meaning that riders need to produce a consistent power output under high (riding on the front) and low (drafting behind a teammate) power conditions. Pedal forces, and therefore power outputs, are primarily generated by muscle moments at the ankle, knee and hip, with an infinite combination of these degrees of freedom available to produce the same output. The aim of this study was to identify the extent to which world class riders exploit redundancy in the lower extremity to achieve a consistent power output, by investigating joint moment variability and joint synergies at different power outputs.
Methods

Five world class female pursuit cyclists completed two ergometer cycling trials at race-specific low- and high-power conditions. The positions of right lower extremity joints were recorded with a sagittal plane camera and crank force data were obtained from 2D instrumented cranks. These data were used to calculate ankle, knee and hip joint moments using inverse dynamics. Within participants variability (14 pedal revs) in joint moments was calculated, and an Uncontrolled Manifold (UCM) analysis (Yen and Chang, 2009) was used to determine the strength of lower extremity synergy (Krishnan et al., 2013). Differences between power output conditions were assessed using Statistical Parametric Mapping (Pataky, 2012).
Results
There was a trend towards increased joint moment variability at higher compared to lower power outputs, at all joints across the entire crank cycle. These differences were significant ($p<0.05$) during periods of the crank cycle. No difference in the strength of lower extremity synergy was apparent between power outputs at any point in the crank cycle ($p>0.05$).
Discussion
Cycling at power outputs representative of riding on the front of a pursuit team resulted in greater cycle-to-cycle variability in joint moments than the lower power output indicative of drafting behind a teammate. Although little research has reported variability in lower extremity joint moments during cycling, this might be expected as there is a requirement to produce larger moments at higher power outputs. However, all riders demonstrated evidence of lower extremity synergy across the pedal cycle and the strength of this synergy was similar between the lower and higher power output conditions. This suggests that this group of riders continued to exploit redundancy in the lower extremity, despite the increase in the magnitude of joint moments associated with higher power outputs.
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Contact
j.wheat@shu.ac.uk

SUCCESSFUL TRAINING DESIGN FOR A ROAD CYCLING ATHLETE WITH KNEE PAIN AND MUSCULAR DYSFUNCTION: A CASE REPORT

KRAUS, K.

UNIVERSITY OF FEDERAL ARMED FORCES MUNICH // UNIVERSITÄT DER BUNDESWEHR MÜNCHEN

Introduction
Cycling athletes commonly suffer from knee pain (Faria, Parker, & Faria, 2005). In this case, a 22-year old road cycling athlete (member of the military national team) reported significant knee and lower back discomfort after practice as well as cramps in the left hamstring during intense racing bouts. It is well known that muscle pain can be caused by a variety of different triggers. One of the relevant aspects when it comes to investigating muscle pain is motor behaviour and will therefore be presented in this case report.
Methods
In order to study general and specific muscle behaviour, a progressive motor screening protocol was applied to examine the role of lower limb symmetry – with a focus on motor behaviour under energetic costs. A progressive squat protocol from 30 to 70 kg (5 sets a 5 reps, recovery: 2 min) was performed. Specific lower limb symmetry was assessed with progressive loads at 3, 4 and 5 watts/kg. Muscle recruitment strategies of the gluteus, quadriceps and hamstrings were determined by EMG shorts (Myontec, 25 Hz) in order to examine bilateral muscle balance deficits. Strength parameters were recorded with a linear power encoder (Smartcoach, 100 Hz). The intervention program addressed the identified motor and strength deficits. In more detail, it consisted of traditional exercises (squats, lunges) and flywheel hamstring curls; SEMG-feedback and unilateral performance feedback during cycling (Garmin Vector) were utilized to enhance motor learning (Sella & Moss, 2016).
Results
Significant overall improvements in motor behaviour and performance were reported as well as a reduction in muscle discomfort after an intervention period of 6 weeks. In detail, squat performance increased from 6.3 to 7.4 watts/kg. Bilateral motor asymmetry was reduced (gluteus maximus: pre: 65%/35%; post: 45%/55%). Cycling specific lower limb symmetry increased from 39% of the left and 61% of the right hamstring to 48% of the left and 52% of the right hamstring at 5 watts/kg.
Discussion
These results suggest that a training program design based on motor screening combined with motor and cycling performance feedback is an appropriate training strategy to improve cycling specific symmetry. In our case study, a high level of general bilateral muscle asymmetry and a cycling specific lower limb asymmetry of the hamstring were detected to be associated with pain and high-intensity related cramps. However, motor asymmetry does not necessarily result in an injury, pain or even decreased performance.
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Oral presentations

OP-BN13 Exercise and the brain

THE STIMULATED CEREBELLUM: APPLICATION OF TRANSCRANIAL DIRECT CURRENT STIMULATION ON THE CEREBELLUM IMPROVES MOTOR ADAPTATION

PIXA, N., STEINBERG, F., DOPPELMAYR, M.

INSTITUTE OF SPORT SCIENCE - JGU MAINZ

Introduction
An adequate motor adaptation is important to react to changes in the environment in everyday life and especially in sports. Neurophysiological studies revealed that the cerebellum is a key structure for motor adaptation. Non-invasive brain stimulation approaches showed

that a modulation of the cerebellum affect motor adaptation (e.g. reduced error rate) and a recently published study by our group showed that anodal tDCS applied to the cerebellum increases performance in a mirror drawing task (Doppelmayr et al. 2016). Purpose of the presented study was built on these findings by investigating cerebellar tDCS effects on a computer-based motor adaptation task.
Methods
Thirty-two healthy, right-handed, young volunteers participated in this double-blind study and were randomly assigned to two groups (STIM (N=16) & SHAM (N=16)). The task was to move a mouse cursor with the right hand as fast and accurate as possible to a target displayed on a computer screen. Each block consists of 24 targets displayed in random positions, but in an equidistance to the starting point in the middle of the screen. After a pretest the motion of the cursor was changed from 0° to a perturbation of 60°. During the adaptation-phase 12 perturbation-blocks (60°) were performed while simultaneously participants of the STIM-group received anodal tDCS (1mA for 20 min.) over the cerebellum (10% below the inion) with four return-electrodes (PO7, PO8, O1 & O2; 10-20-EEG-System), whereas participants of SHAM only received sham stimulation. Immediately after the adaptation-phase and again after a time period of 20 minutes posttests were conducted. Mean initial error (IEr) and reaction time (RT) were analyzed by 2x4 ANOVAs.
Results
For the IEr the results showed a significant main effect of TIME [$F(2,58) = 27.8$, $p < .001$, $\eta p^2 = .49$] and a significant interaction of TIMExGROUP [$F(2,58) = 3.69$, $p < .001$, $\eta p^2 = .11$] indicating reduced IEr for STIM. For RT a significant main effect of TIME [$F(2,58) = 37.1$, $p < .001$, $\eta p^2 = .56$], but no significant interaction emerged. Neither for IEr nor for RT significant main effects for GROUP were found.
Discussion
Our results fit well with the concept that the cerebellum is significantly involved in motor adaptation and confirm recent findings within tDCS studies. Further, our data reveal a beneficial effect of cerebellar tDCS on motor adaptation, a finding which opens up applications within sport-specific training and research.
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Contact
pixa@uni-mainz.de

GRAY MATTER VOLUME AND WHITE MATTER INTEGRITY ARE CORRELATED WITH SUBSEQUENT COMPLEX MOTOR SKILL ACQUISITION

LEHMANN, N.1,2, TOLENTINO-CASTRO, J.W.3, KAMINSKI, E.1, FRITZ, T.1, RAGERT, P.1,3, VILLRINGER, A.1,4, TAUBERT, M.1,5
1:MPI-CBS (LEIPZIG, GERMANY), 2:MSS (FRIBOURG, SWITZERLAND), 3:WWU (MÜNSTER, GERMANY), 4:UHL (LEIPZIG, GERMANY), 5:OVGU (MAGDEBURG, GERMANY)

Introduction
Structural constraints imposed by the brain are thought to determine subsequent plasticity in interaction with environmental stimuli such as learning (Lövdén et al., 2010). In line with this assumption, structural brain measures are correlated with inter-individual differences in a wide range of behavioral and cognitive domains (Kanai & Rees, 2011). However, it remains largely underexplored to date whether such a brain structure-behavior relationship does also apply for the acquisition process of complex motor skills (Sampaio Baptista et al., 2014). We hypothesized that baseline variations in local properties of gray (GM) and white matter (WM) are related to subsequent complex motor skill acquisition.
Methods
To test this assumption we conducted a retrospective cross-sectional study and included datasets of 75 (GM) and 59 (WM) healthy, young subjects aged 20-35, respectively. Subjects first received a T1-weighted MPRAGE and/or a diffusion-weighted MRI-scan. After baseline scanning, subjects engaged in one training session (TS) of a complex whole-body balancing task (BT) on a seesaw-like platform (Taubert et al., 2010). Several performance indices of motor skill acquisition were calculated and subsequently associated with GM and WM properties at baseline using regression models.
Results
Better initial performance of the skill was associated with higher GM volume in the superior parietal lobe, whereas the gain in performance (learning rate, LR) was correlated with local GM volume in the inferior (IFG) and medial frontal gyri (MFG). Also, local IFG volume showed positive correlations with terminal performance (TP) and the best trial (BT) of the TS. These findings were complemented by positive relationships between fractional anisotropy (FA) in the WM underlying the PFC and behavior (LR, TP).
Discussion
The potential to learn a complex motor skill is correlated with a priori structural properties of GM and WM. The results highlight especially the role of frontal brain areas and their connecting fibre tracts in the early motor learning process. Of note, prefrontal areas were also shown to be plastic in response to practicing the BT (Taubert et al., 2010).
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Contact
nico.lehmann@unifr.ch

A CAFFEINE-MALTODEXTRIN MOUTH RINSE COUNTERS MENTAL FATIGUE.

VAN CUTSEM, J., DE PAUW, K., MARCORA, S., MEEUSEN, R., ROELANDS, B.
VRIJE UNIVERSITEIT BRUSSEL

Introduction
Mental fatigue is associated with a shift of electroencephalography (EEG) power towards low-frequency bands (θ, α), which is suggested to be related to a decrease in the level of arousal. In addition a decrease in the amplitude of event related brain potentials like P2 (i.e. an index of activity engaged in selection of relevant information) is also observed with the occurrence of mental fatigue. In order to further

elucidate the role of these brain alterations in the occurrence of mental fatigue we sought to prevent them with a caffeine-maltodextrin (CAF-MALT) mouth rinse intervention during a mentally fatiguing task.
Methods
Ten active healthy males (age: 23±2y, physical activity: 7.3±4.3h/week), which were all low CAF users (101±97mg/day), performed two experimental trials in a randomized crossover order. In both trials participants first completed a baseline Flanker task (3min). Next they performed a 90-min mentally fatiguing task (Stroop task), that was immediately followed by a Flanker task. Before the start and after each 12.5% of the Stroop task (8 blocks of •11min) subjects received either a CAF-MALT mouth rinse (MR; 0.3g/25ml CAF; 1.6g/25ml MALT) or placebo (PLAC; 25ml artificial saliva). To measure mental fatigue, physiological and psychological measures were assessed. EEG (32 active electrodes) was applied throughout the experiment to record brain activity. Normality was checked, repeated measure ANOVAs were employed to observe interaction and/or main effects of condition and/or time. Follow up tests were performed where necessary.
Results
Self-reported mental fatigue was lower in MR compared to PLAC (p=0.017). Normalized accuracy (accuracy on first block=100%) was higher in the eighth and last block of the Stroop task in MR (100.4±1.6%) compared to PLAC (91.0±3.5%; p=0.032). Also Flanker accuracy in MR was higher than in PLAC (p=0.031). No effect on normalized blood glucose concentration was observed. P2-amplitude in the dorsolateral prefrontal cortex (DLPFC) decreased in time in PLAC (p=0.017), whilst in MR time did not have an effect. Normalized α1-power increased in time in PLAC (100% → 154.1±17.2%; p=0.004) whilst in MR there was no increase. Normalized α1-power in the last time interval was significantly higher in PLAC (154.1±17.2%) than in MR (104.2±11.1%; p=0.039).
Discussion
A CAF-MALT mouth rinse postponed the decrease in P2-amplitude in the DLPFC and also the increase in α1-power in time. In addition the CAF-MALT mouth rinse had no effect on blood glucose. The CAF-MALT mouth rinse induced brain changes appear to be associated with a lower perception of mental fatigue and a longer ability to maintain cognitive performance (i.e. markers of mental fatigue).

PREPARATORY CORTICAL AND SPINAL SETTINGS TO COUNTERACT ANTICIPATED AND NON-ANTICIPATED PERTURBATIONS

WÄLCHLI, M., TOKUNO, C., RUFFIEUX, J., KELLER, M., TAUBE, W.
UNIVERSITY OF FRIBOURG

Introduction
Feedforward control is used to adapt postural reactions in response to perturbations that can be anticipated (Horak et al., 1989). However, little is known about the way the central nervous system prepares postural reactions to anticipated perturbations. To investigate this, participants were exposed to translational and rotational perturbations in both anticipated (block design) and non-anticipated conditions (random design). It was hypothesized that in the anticipated conditions, activity of the soleus muscle should be reduced in rotations and enhanced in translations in order to more efficiently counteract the perturbation.
Methods
Postural responses after perturbation were analyzed by comparing the root mean square (RMS) of the EMG signal during the time of the short- (SLR; 30-60ms), medium- (MLR; 60-85ms), and long-latency response (LLR; 85-120ms) during anticipated (blocked) or non-anticipated (random) rotations and translations. Preparatory setting was measured by evoking H-reflexes, motor evoked potentials (MEP), and short-interval intracortical inhibition (SICI) shortly before (30ms) the onset of perturbation in the m. soleus of 15 healthy adults.
Results
Postural responses remained unchanged for SLR and MLR, but LLR was decreased in anticipated rotations ($p = .002$) and increased in anticipated translations ($p = .046$) compared to the corresponding non-anticipated perturbation. H-reflexes elicited before perturbation were different between conditions ($p = .023$) with higher amplitudes for translations compared to rotations ($p = .037$). Main effects for SICI were found ($p < .001$) with less inhibition in all perturbation conditions compared to the static standing task.
Discussion
Muscular responses after anticipated perturbations were adequately, i.e. perturbation-specifically adapted at the level of the cortically-mediated LLR. In contrast, no significant changes were observed at the spinally-mediated SLR and MLR. Thus, when solely regarding the EMG after perturbation, the preparatory setting seemed to mainly affect cortically-mediated responses. However, H-reflexes elicited shortly before onset of perturbation were increased in anticipated translations and decreased in anticipated rotations, indicating that the preparatory setting also affected spinal Ia-afferent transmission. In addition, intracortical inhibition was reduced as soon as subjects expected any kind of perturbation. Thus, spinal and cortical adaptations seem to act in synergy in order to adequately prepare the reaction in response to anticipated perturbations.
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Contact
michael.waelchli@unifr.ch

SKILL-RELATED CENTRAL MOTOR BEHAVIOUR PRECEDING LATERALIZED PRACTICE PATTERNS IN SHORT BADMINTON BACKHAND SERVES

SKRZEBA, C.1, HOFFMANN, D.1, STUCKENSCHNEIDER, T.2, VOGT, T.1
1PROFESSIONAL SPORT EDUCATION AND SPORT QUALIFICATIONS; 2 INSTITUTE OF MOVEMENT AND NEUROSCIENES, GERMAN SPORT UNIVERSITY

Introduction
Motor behavioral processes preceding voluntary movements involve, at least in part, central sensorimotor modulations that have been detected by analyzing the readiness potential (RP). However, RP evidence often refers to non-sport specific but sport-related actions (e.g. finger tapping in professional vs. novice rifle shooters) mostly examined in laboratory setups. Thus, RP responses to a real sport-specific movement in sport-specific setups (e.g. on court) remain to be elucidated. The present study aimed to investigate RP preceding short Badminton backhand serves.
Methods
Voluntarily 18 healthy right-handed men participated in this study. Participants were divided into two groups: professionals (P, n=10: 26,1 ± 4,9 years; 184,9 ± 4,0 cm; 79,1 ± 9,7 kg) with national level experience and amateurs (A, n=8: 22,3 ± 3,5 years; 183,6 ± 7,5 cm; 79,8 ±

10,7 kg) with basic university-class experience. After familiarization, each participant performed 60 short backhand serves that were randomly assigned into 30 consecutive dominant hand (RHS, right-hand serve) and 30 non-dominant hand serves (LHS, left-hand serve), in each serve aiming for accuracy (three-staged target zone from outside 0.25 to 0.5 to inside 1 point in a 60 cm equal-sided triangle oriented to the mid line and service line corner). Surface EMG from left and right extensor carpi radialis were synchronized and recorded together with 32 Ag/AgCl EEG channels, particularly mounted over sensorimotor areas. EMG signals served as muscle activation onsets to detect RP onset and peak.
Results
For RP onset, there was no significant interaction between groups and serves ($p=0.70$); however, main effects showed that RHS (P -2016 ± 558 ms, A -2312 ± 425 ms) preceded earlier RP onset (longer preparation time) compared to LHS (P -1898 ± 565 ms, A -2157 ± 422 ms; $p<0.05$), whereas RP onset was not modulated by P and A ($p=0.25$). RP peak interacted between groups and serves ($p<0.05$), revealing a decrease in amplitude (i.e. larger negativity) for P RHS (-10.39 ± 5.95 µV) compared to A RHS (-2.68 ± 4.45 µV; $p<0.05$) only. Serving accuracy interacted ($p<0.001$), revealing increased points in P RHS (0.59 ± 0.82 points) compared to P LHS (0.26 ± 0.09; $p<0.001$ points) as well as in P compared to A (RHS: 0.29 ± 0.09 points, LHS 0.23 ± 0.08; $p<0.001$ points).
Discussion
The present applied findings support previous non-sport specific results reporting earlier RP onset and larger RP peak to indicate increased neuronal preparation times and requirements in order to precisely perform complex movements (i.e. short backhand-serve), thus, more pronounced in well-trained (i.e. professionals, dominant hand) compared to less or unfamiliar movements (i.e. amateurs, non-dominant hand).

SPORT-SPECIFIC MOVEMENT-PRECEDING CORTICAL MOTOR LEARNING PROCESSES DURING ARCHERY – APPROACHING SKILL ACQUISITION

VOGT, T.1, KANOSUE, K.2, KATO, K.2

1GERMAN SPORT UNIVERSITY COLOGNE, 2WASEDA UNIVERSITY

Introduction
Research on central motor learning and behavioural processes preceding voluntary movements often refers to analysing the readiness potential (RP). For this, numerous studies used laboratory setups with controlled sports-related actions (i.e. finger tapping connatural to rifle trigger pulling). Additionally, more applied approaches focus on athlete to non-athlete comparisons, omitting evident effects of training and gained experience on RP. However, RP preceding real sport-specific movements in accordance to skill acquisition in novices remains to be elucidated.
Methods
Following familiarization, 16 right-handed males (age 30 ± 6 yrs, height 182 ± 6 cm, weight 80 ± 11 kg) with no experience in archery volunteered to perform 40 shots at 60 seconds rest on a standard distant (15 m) and sized (d 40 cm) target. Given their attained scores on target, participants were assigned into a skilled (140 ± 24 points) and less skilled (56 ± 17 points) group ($p<0.01$). Continuous recordings and synchronisation of EEG (32 Ag/AgCl-channels with electrodes sites mounted over movement-related cortical motor areas) and right limb EMG (i.e. extensor carpi radialis muscle, ECR) during arrow-releasing served to detect movement onsets for RP analyses.
Results
Mean baseline to peak values of ECR muscle activity revealed no significant changes ($p>0.05$), whereas RP amplitudes and onsets differed between groups; arrow-releasing preceded larger RP amplitudes ($p<0.05$) and later RP onsets ($p<0.05$) in skilled compared to less skilled novices.
Discussion
Preceding a crucial part during a complex real sport-specific movement sequence (i.e. accurate arrow-releasing after raising and drawing the bow as well as aiming for the target), we suggest our findings to reflect greater effort and attentional orienting that accompany central preparatory motor behavioural processes in skilled compared to less skilled novices.

Oral presentations

OP-PM29 Monitoring team sport athletes

SEASONAL VARIATIONS IN TRAINING, PHYSICAL FITNESS, AND ANTHROPOMETRY IN FEMALE ELITE YOUTH SOCCER PLAYERS: THE ROAD TO THE GERMAN CHAMPIONSHIP

LESINSKI, M., HELM, N., PRIESKE, O., GRANACHER, U.

UNIVERSITY OF POTSDAM

Introduction
Monitoring changes in training volume and physical fitness throughout a whole soccer season provides relevant information on the effects of training periodization as well as on the intra-seasonal stability of performance measures. Thus, the purpose of this study was to describe variations in training contents and volume, physical fitness, sport-specific performance, and anthropometry during the different training periods of a soccer season. In addition, potential associations between changes in training characteristics and performance measures were examined in female elite youth soccer players.
Methods
The seasonal training (i.e., day-to-day training volume and content) as well as the variations in measures of physical fitness (i.e., muscle strength/ power, speed, agility, balance), sport-specific performance (i.e., kicking velocity), and anthropometry (i.e., segmental muscle and fat mass) were collected from 17 female elite youth soccer players with a mean age of 15.3±0.5 years (3 years post peak-height-velocity) during the different training periods (i.e., preparation, competition, transition) of the season that led to the German under-17 (U17) championships in female soccer.
Results
Repeated measures ANOVA indicated significant variations in training volume and contents as well as in physical fitness, sport-specific performance, and anthropometry over the course of the soccer season. When comparing the different training periods, significantly more resistance, endurance, and coordination training was conducted during the two preparation periods ($2.0 \leq d \leq 18.2$; $p<0.05$), whereas

more sprint, technical, and tactical training was realized during the two competition periods (0.3≤d≤11.2; p<0.05). In terms of performance measures and anthropometry, our findings revealed mainly significant improvements during the first leg of the season. Over the course of the entire season, total muscle mass, kicking velocity, jump, balance, and shuttle run performance significantly increased (2.4≤d≤4.0; p<0.05), whereas maximal leg muscle strength significantly decreased (d=2.5; p<0.01). Pearson correlation coefficient revealed small-to-medium associations between training contents and changes in performance measures (r=0.53-0.88; p<0.05).
Discussion
The systematic documentation of training and performance data over an entire soccer season allows to evaluate training periodization and training effectiveness. In addition, seasonal variations of individual athletes can be detected and used to better tailor training programs.

EFFECTS OF THE COMPETITIVE SEASON ON THE ISOKINETIC MUSCLE PARAMETERS CHANGES IN WORLD CLASS HANDBALL PLAYERS

MAURELLI, O.
UNIVERSITÉ D'AMIENS

Introduction
Handball is a collective olympic sport of opposition characterized by defensive and offensive actions with a wide variety such as duels, jumping, sprinting, shooting and changing direction. The physical abilities of strength, speed, power and endurance are essential to be performing in handball (Marques and Gonzales-Badillo, 2006). These qualities are invariably solicited during training and competing actions requiring usually high levels of strength and power for both quadriceps (Q) and hamstring (H) muscles. Very few studies have shown interest in the effects of a whole competition season on the isokinetic muscular characteristics in athletes (Hoffman et al., 1991 ; Kraemer et al., 2004 ; Eniseler et al., 2012). So far, no studies have been conducted in the longitudinal follow-up of muscular adaptations in world-class handball players over a full competitive season. The objective of this investigation was thus to study changes, in lower limbs, of isokinetic muscular characteristics over a full competitive season in world-class handball players.
Methods
19 male handball players, all French or foreign international handball players, belonging to the Ligue 1 club Montpellier Handball (MHB - France), participated in this study. Subjects were evaluated using a Biodex Isokinetic Dynamometer 3® System (Biodex Corporation, Shirley, NY) with gravity correction. Two bilateral tests of knee joint flexors (H) and extensors (Q) were performed in concentric and eccentric mode at the beginning of season (in September, after the pre-competitive preparation period (Pc2P)) and at the end of season (in June). The evaluation was performed on the dominant leg (DL) and non-dominant leg (N-DL) in concentric (60°.s-1 and 240°.s-1) and eccentric (30°.s-1) modality, in order to determine the peak torque (PT) and mean power (MP).
Results
The end-of-season values observed in our study showed that the regular practice of handball (n=180 technical-tactical training sessions and n=60 games) associated with muscle strengthening sessions (n=35) (i) allows to maintain isokinetic strength parameters (PT and MP at 60°.s-1 and 240°.s-1) in Q and H for N-DL and (ii) induced a significant decrease (p<0.001) on DL of PT values in concentric mode at 60°.s-1 in Q and H. The MP values show a significant decrease (p<0.001) on DL, in H during concentric mode at 240°.s-1 and a significant increase (p<0.001) on DL and N-DL in H at 30°.s-1.
Discussion
Given the general trend of our results, it would be interesting, at the beginning of the competitive season, to increase, as much as possible, the strength and muscle power values, in order to benefit from these increases throughout the season. In very high level sport, the most interesting period to increase strength and muscle power values is probably the Pc2P, lasting 6 to 8 weeks depending on the sports discipline.

AN AUTOMATED SOLUTION FOR PLANNING, TRAINING AND ANALYZING PERFORMANCE IN TEAM SPORTS: APPLICATION TO BASKETBALL

SANTOS, W., BARRERA, J., LAMAS, L.
UNIVERSITY OF BRASILIA

Introduction
A team performance in a game depends on the design of an appropriate team strategy, followed by the criteria applied to define the training contents and the data gathered in the game to reinforce or fix team strategy and training contents. Integrate these contents and automate the related processes may help coaches practice.
Methods
We applied a formal language to support the design of a team strategy (Lamas et al., 2014) in a virtual environment and used an algorithm that interprets the semantics of each action specified in the strategy. Recognized actions were stored in a database. Second, we defined metrics to analyze the database trends to provide support for a coach decision on the training contents (e.g. analysis of the emphasis given to content in a period). Third, using a regular expression language (Jeffrey, 2006) to standardize the data entry of observed game events.
Results
After systematic tests, the algorithm developed in the strategy design interface was able to complete capture the set of possible draws that relate to basketball action structures. The structure of the database supported the definition of accurate metrics for assessing a coach's decision trends on training processes, generating helpful feedback on his choices. Finally, the use of regular expressions language, implemented through computer keyboard shortcuts demonstrated to be sufficient for acquiring, in real-time, by a single annotator all contents that compose the team strategy.
Discussion
In the present work, the previously unintegrated contents related to team strategy design, training process and game analysis could be connected and automated through a computational support. It constitutes an innovative approach to strategy planning, distribution of strategic contents in training sessions and analysis of the application of strategy in games. Coaches are familiar with the process of planning new content and options to maximize the team performance. In many cases, a coach draws his plays in a software environment, however, the efficiency in retrieving information and its use to support decisions about what to train is low, because the process generally does not consider using information from databases. Coaches can take advantage of this solution by easily assessing the

team strategy in different levels of resolution and the reports from each step of the process may be helpful to understand his own trends in terms of training preferences and to maximize game performance.
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Contact
wellrangel@gmail.com

HEART RATE MEASURES DURING A HIIT SHOCK MICROCYCLE - A METHODOLOGICAL COMPARISON

SCHNEIDER, C., WIEWELHOVE, T., RAEDER, C., DÖWELING, A., FERRAUTI, A.
RUHR-UNIVERSITY BOCHUM

Introduction
Monitoring the cardiac autonomic nervous system (ANS) using heart rate (HR) and heat rate variability (HRV) might give useful insights into athletes training response. Several methods for data treatment and practical thresholds had been suggested, without reaching scientific consensus, yet [1,2]. Aim of the study was to compare common HR and HRV analysis methods for monitoring fatigue and recovery during a HIIT shock microcycle.
Methods
18 intermittent sport athletes (mean±SD, age 25.2±2.8 yrs, VO2peak 58.3±8.8 ml/min/kg) completed a 6-day running-based HIIT microcycle (eleven sessions total). HR and HRV (Ln rMSSD) were assessed daily upon awakening during a 4-day baseline, a 6-day shock microcycle and a 4-day recovery period. HR and HRV were calculated using the last 5 min of a 7-min recording. Changes in repeated-sprint ability (RSA, criterion measure), HR and HRV were analyzed using magnitude-based inferences [3] between baseline (BL), one (fatigued, FAT) and four days (recovered, REC) after the microcycle. Test accuracy was derived from 2x2 contingency tables and ROC curves (area under the curve, AUC) for different concepts of meaningful change (typical error: TE, individual variability: CV or Z-score, performance equivalent: SWC). All analysis of daily and 4-day rolling averages (4d) of HR and HRV were performed for individual Z-scores, absolute and percent changes.
Results
RSA showed very likely small changes at FAT (-3.2%) and REC (+3.7%). 4d-HR displayed possibly to most likely small changes (FAT +1.5 bpm, REC -2.9 bpm) and likely small reductions (-2.0 bpm) at REC for daily HR. HRV-changes remained trivial. Likely moderate correlations (r=.38-.45) between changes in RSA and daily HR, as well as daily HRV at FAT were observed for individual Z-scores. Test accuracy was higher in daily vs. 4d-values for HRV-changes and HR-changes at FAT. 4d-HR at REC was more accurate than daily HR. Threshold concepts based on individual variability showed highest test accuracy (44-67%). Overall accuracy for detecting RSA-changes was insufficient (AUC for Z-scores: 0.2-0.7).
Discussion
Overall, daily HR and HRV were superior to 4-day averages, with HR being closer related to RSA-changes than HRV. Present findings indicate the usefulness of considering individual variability, compared to fixed benchmarks such as TE or SWC. Independent of data treatment and threshold concept ANS-alterations were poorly related to overload induced short-term performance changes. Current results display an important starting point for future multivariate analysis using ANS-markers.
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Contact
christoph.schneider-a5c@rub.de

JUMP TESTING TO ASSESS RESTORATION OF PERFORMANCE IN ELITE RUGBY UNION PLAYERS

ADAM, G., BOREHAM, C., JONES, P.A., MCMAHON, J.J., COMFORT, P.
UNIVERSITY COLLEGE DUBLIN

Introduction
Professional rugby union is a physically demanding game. Little is known, however, about the time-course to restore neuromuscular performance following matches, particularly in relation to positional play of forwards and backs. Such information would be useful in optimising performance and recovery, given that consecutive matches may be played after as few as four days. The purpose of this study, therefore, was to compare neuromuscular performance measured by countermovement jump (CMJ) at baseline (pre-match) and at three recovery times post-match in forwards (n = 12) and backs (n = 15).
Method
Male professional players (age 27.7 ± 4.6 years, bodyweight, 98.1 ± 11.2 kg, height 184.3 ± 6.3 cm) performed a single CMJ under standardised conditions at baseline (0) and 60, 90 and 170 hours post match. CMJ height was calculated using flight time, and differences in performance analysed with repeated measures ANOVA's and Bonferonni post hoc analysis. Friedman's tests were also conducted to compare jump heights at all timepoints for both forwards and backs.
Results
As a group, player's CMJ performance was significantly reduced at 60 hours post-match (-2.6 ± 4.8cm), 90 hours post-match (-2.8 ± 5.4cm) and 170 hours post-match (-1.2 ± 5.1cm; all $p > 0.05$). Friedman tests revealed no significant differences in jump height for forwards across timepoints compared with baseline (0 hours 36.9 ± 0.82 cm; 60 hours 35.7 ± 0.97 cm; 90 hours; 35.4 ± 1.06 cm; 170 hours 36.7 ± 0.94 cm). In contrast, significant differences in jump height were noted for backs across timepoints from baseline (43.2 ± 3.9 cm) to 60 hours (39.0 ± 3.2 cm, $p < 0.001$, $d = 2.30$), 90 hours (39.1 ± 3.9 cm, $p < 0.001$, $d = 2.57$) and 170 hours (41.0 ± 3.9 cm, $p = 0.005$, $d = 1.57$).
Discussion
Our results showed that a decrement in jump height exists for up to seven days post match. This finding is of potential importance for the elite game, where the frequency of fixtures and match demands are increasing. Furthermore, our results showed differences between forwards and backs, such that the latter displayed greater and more prolonged decrements in post match performance. This is contrary

to previous research (Jones et al., 2014; Lindsay, Draper, Lewis, Gieseg, & Gill, 2015; Quarrie, Hopkins, Anthony, & Gill, 2013), which suggested that forwards should be provided with more time to recover post match than backs. Future investigation should investigate the specific match demands that lead to these differences. Such information could then be used to guide post match recovery strategies according to position of play.

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EFFECT OF THE COLLECTING METHOD ON SESSION-RPE IN YOUTH SOCCER PLAYERS

FANCHINI, M.1,3, MODENA, R.1,2, DE GRANDIS, D.1, SCHENA, F.1,2

1: UNIVERSITY OF VERONA (VERONA, ITALY), 2: CERISM, UNIVERSITY OF VERONA, (ROVERETO, ITALY), 3: U.S. SASSUOLO CALCIO (SASSUOLO, ITALY)

Introduction
The assessment of the Rate of Perceived Exertion (RPE) is widespread in soccer to calculate the session-RPE that is a valid method to assess training load (TL) (Foster et al., 2001). Instructions on the RPE assessment indicated that the rating has to be collected confidentially (CONF) after the training1, however sometimes fitness coaches use a non-confidential (NCONF) modality that may be biased by the influence of other players. The aim of this study was to examine the effect of NCONF modality on the RPE rating.
Methods
Twenty young soccer players (age 16±0.1 years, height 176±8 cm, body mass 67±13 kg) participated in a crossover design study. After presentation of the Borg CR-100 scale, players were familiarized with the scale for 3 weeks. A memory and exercise (Yo-Yo Intermittent Recovery Level 1) procedures were used to anchor the scale. Players were randomly divided in 2 conditions: CONF and NCONF. Internal TL was assessed with heart rate based methods: Edward's TL and Banister TRIMP. External TL was monitored in 8 players with GPS as total distance (TD) and high intensity distance (HI>14.4km/h). After each session the players were interviewed (CONF) or wrote their RPE value on a blackboard attached in the team dressing room (NCONF). Mean differences (90%CI) in RPE, internal and external TL between the 2 conditions were analyzed. Coefficients of variation (CV) were calculated for RPE and Bland & Altman plot with limits of agreement (LOA) were used two check interchangeability between the two assessments.
Results
No differences were found for Edward's TL and Bannister TRIMP in the 2 conditions (mean difference, 90%CI: 3.0, -1.7 to 7.7 AU and 1.9, -1.1 to 4.8 AU). No differences were found for TD and HIR in the 2 conditions (mean difference, 90%CI: -93, -269 to 83m and -66, -157 to 25m). RPE were 31.3±7.3 and 30.1±4.4 AU with no difference between the 2 conditions (-0.4, -2.2 to 1.5 AU). CV were 0.23 (90%CI 0.19 to 0.32) and 0.14 (90%CL 0.11 to 0.20) for CONF and NCONF, respectively. Bland & Altman plot showed bias -0.35 (95%CI: -2.6 to 1.9) and LOA of -9.7 to 9.0 AU.
Discussion
Two training sessions with the same internal and external TLs were performed. RPE assessed in 2 different modalities showed similar values. However, the variability in NCONF condition was lower than in CONF, Bland Altman plot showed that some players provide different rating in the 2 conditions. The first RPE written in the NCONF modality may have influenced subsequent players in their rating. Coaches should use a confidential modality and follow instructions in the assessment of RPE.

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Contact
maurizio.fanchini@gmail.com

Oral presentations

OP-PM57 Training and exercise in clinical populations 2

SAFETY AND TOLERANCE OF THE INFLUENZA VACCINE IN POLISH ELITE ATHLETES - OUR EXPERIENCE FROM THE OLYMPIC GAMES IN 2016.

KRZYWANSKI, J.1, KUCHAR, E.2, POKRYWKA, A.1,3, KRYSZTOFIAK, H.1,4, MIKULSKI, T.4, JURCZYK, J.1, PIETRAK, A.1, PILCHOWSKA, I.5, NITSCH-OSUCH, A.2

1: COMS (WARSAW, POLAND) 2: WUM (WARSAW, POLAND) 3: UZ (ZIELONA GORA, POLAND) 4: MRC PAN (WARSAW, POLAND) 5: SWPS (WARSAW, POLAND)

Introduction
In Poland a peak incidence of influenza is reported between January and March, while in Brazil from July to September. The most effective way to prevent influenza is vaccination. The Olympic Games were held in August 2016 in Rio de Janeiro (southern hemisphere) where the influenza vaccine, recommended by WHO, was different from vaccine for the northern hemisphere. This had created a need for the additional vaccination for athletes attending the Olympic games. The aim of the study was to evaluate the safety and tolerance of the trivalent inactivated influenza vaccine recommended for the Northern Hemisphere season 2015/2016 and for the Southern Hemisphere for the season 2016 in elite athletes.
Methods
Athletes were vaccinated twice: the first vaccine (for northern hemisphere) was given in October 2015-January 2016 (NORTH group, 136 persons aged 19-40); the second vaccine (for southern hemisphere) was given in June-July 2016 (SOUTH group, 132 persons, aged 19-40), 39 athletes were vaccinated with both vaccines (NORTH+SOUTH).
Results
The most often reported side effects were local reactions (NORTH vs. SOUTH): pain at the injection site (53% vs. 29%), redness (27% vs. 8%), combined local symptoms (18% vs. 6%) and edema (13% vs. 4%). The most frequently recorded general symptoms were: malaise

(13% vs. 14%), headache (11% vs. 7%), and myalgia (11% vs. 12%). We observed a similar incidence of local and general reactions in athletes who obtained both vaccinations. 18 persons of the NORTH group and 14 persons of the SOUTH group declared that vaccination impacted negatively on their training program, nevertheless only 2 athletes modified their training programs. In athletes who obtained both vaccinations, 3 persons after the first and 1 person after the second vaccination declared that vaccination impacted negatively on their training program but nobody modified the training program.
Discussion
1. The elite athletes tolerate the inactivated trivalent influenza vaccine well, but short-term interference with their training schedule on the day of vaccination and the day after should be expected.
2. The subsequent vaccination against influenza with two vaccines (for South and North Hemisphere) within the same season is safe, well tolerated and does not increase the risk of side effects.
3. We recommend annual influenza vaccination for elite athletes, and in cases where athletes travel to the other hemisphere, vaccination should be carried out twice a season for both North and South hemisphere. In order to minimize the risk of possible interference with the training schedule influenza vaccines should be administered during the days while an intensive training is not planned.
Contact
jarek.krzywanski@coms.pl

EFFECTS OF A 1-WEEK STAY IN THE MOUNTAINS ON 20-M SHUTTLE RUN TEST PERFORMANCE IN CHILDREN WITH ASTHMA

FRANCESCATO, M.P., CETTOLO, V., CANCIANI, M.
UNIVERSITY OF UDINE

Introduction
Exercise induced bronchoconstriction (EIB) affects up to 80% of children with asthma, climatic conditions and air quality having an influence on the occurrence of EIB. Several tests are used to confirm EIB, the exercise-challenge test (ECT) being one of the most common ones.
The 20-m shuttle run test (20mSRT) was used as ECT to investigate the EIB in a group of children diagnosed with asthma at the start and end of a 1-week summer camp in the mountains (about 900 m above sea level).
Methods
On the first and last day of the camp, 24 children from an urban area (age range 7-16y, 16 mild, 6 moderate, 1 severe asthma) performed a 20mSRT and underwent spirometry (Spirolab, MIR, IT) just before, at the very end and 10 minutes after the end of the effort. Percentiles of 20mSRT performances, expressed as number of performed shuttles, were assigned according to De Miguel-Etayo (2014) and to Tomkinson (2016); spirometry z-scores were derived from GLI-2012 equations (Quanjer, 2012). A repeatable flow-volume curve at each testing point was required. EIB was defined as a FEV1 decrease ≥10% in either of the two tests after the 20mSRT (Crapo, 2000).
Results
Baseline spirometry values (and z-scores) for FVC, FEV1 and FEV1/FVC were 2.85±0.78 L (0.09±0.97), 2.48±0.74 L (0.10±0.95) and 0.87±0.06 (–0.02±1.03), respectively. On the first day, a low performance (<25° percentile) in the 20mSRT was observed in 11/24 children (46%) and 14/24 children (58%) had a positive ECT; 8 children showed low 20mSRT performance and positive ECT. At the end of the stay in the mountains, the number of children with low 20mSRT performance decreased to 4/24 (16%) and a positive ECT was observed in 8/24 (33%); only 1 child showed a low performance and a positive ECT. Fisher's exact test showed that, after the 1-week camp, the frequency of EIB was not changed (p=ns); there was a tendency to a lower frequency of low 20mSRT performance (p<0.10); the frequency of observing both EIB and a low exercise performance was significantly reduced (p<0.05).
Discussion
In our cohort, the 20mSRT performance after the one week stay in the mountains was improved in particular in those children where the exercise-induced bronchoconstriction was reduced.
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Contact
mariapia.francescato@uniud.it

PREVALENCE OF THE FEMALE ATHLETE TRIAD AMONG SECONDARY SCHOOL ATHLETES IN SINGAPORE

MUKHERJEE, S., CHOONG, P.P.
NATIONAL INSTITUTE OF EDUCATION, NANYANG TECHNOLOGICAL UNIVERSITY, SINGAPORE

Introduction
The Female Athlete Triad involves three interrelated components on a continuum- low energy availability, menstrual dysfunction, and low bone mineral density. Female athletes, particularly young adolescents, are at risk of developing the triad and its components. While the condition is of global concern, published data on Singaporean female adolescent athletes is unavailable.
Methods
220 female athletes representing nine sports from secondary schools in Singapore participated in a cross-sectional survey. Low energy availability was assessed using participant Body Mass Index (BMI) and the Eating Disorder Examination Questionnaire (EDE-Q 6.0). Menstrual irregularity and bone health was assessed using self-reported menstrual and injury history questionnaires.
Results
Prevalence of the Female Athlete Triad was low (2.3%), while 15% participants were found with two components, and 48.6% presented one. No significant difference was found between eumenorrheic and non-eumenorrheic athletes for BMI (p= 0.64), dietary restriction (p= 0.52), shape concern (p= 0.61), eating concern (p= 0.23), weight concern (p= 0.28) and global scores (p= 0.35), and menarcheal age (p=0.68).
Discussion

Although overall prevalence of the full triad was low, a large number of adolescent active females may be susceptible to progress of the triad beyond an innocuous stage, for components occur on a continuum. A multi-faceted approach involving all stakeholders is critical for its effective prevention.

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THE INNOVATIVE MOTOR INTERVENTION EFFECT IN CHILDREN ATTENDING THE TEACH ROOM

LOURENÇO, C.1, ESTEVES, D.1.2, NUNES, C.3

1DEPARTMENT OF SPORT OF SCIENCE, UNIVERSITY OF BEIRA INTERIOR 2CIDESD (CENTRE FOR RESEARCH IN SPORTS, HEALTH AND HUMAN DEVELOPMENT) 3DEPARTMENT OF MATHEMATICS AND CENTRE OF MATHEMATICS AND APPLICATION

Introduction
The rooms where the Teacch (Treatment and Education of Autistic and Related Communication Handicapped Children) methodology is developed, present a space, materials and organized activities with the purpose of helping children with autism, allowing them to attain autonomy in adulthood (Lima, 2012). These children present motor deficits (Soares & Neto, 2015), such as problems related to balance (Vernazza-Martin et al., 2005), motor coordination (Fournier, Hass, Naik, Lodha & Cauraughno, 2010) and postural control (Kohen-Raz, Volkman & Cohen, 1992). Therefore, a didactic unit was implemented based on trampoline and coordinative exercises with the objective of improving these difficulties.
Methods
Twelve children, aged between 4 and 10, both male and female who were attending the Teacch room, were selected. The experimental group (GE, n = 6) benefited from 2 weekly classes, during 10 weeks, which were based on trampoline jumps and coordinative exercises. On the other hand, the control group (CG, n = 6) did not carry out this didactic unit. Both groups were assessed in 3 different moments, at the beginning, after 5 weeks and at the end, with regard to motor proficiency. This was assessed by the Bruininks-Oseretsky Test (BOT-2, 2nd ed.). To evaluate the effectiveness of the didactic unit we used the Autism Treatment Evaluation Checklist (ATEC).
Results
Regarding the variables studied (BOT-2, ATEC), there was a significant interaction between the group and the 3 assessment moments ($p < 0.05$). Regarding the BOT variable, there was a significant evolution between the 3 different moments of evaluation in the experimental group. The control group does not show any significant developments. In ATEC, the progress is only significant, in the experimental group and from the 1 st to the 3 rd moment.
Discussion
The implementation of the didactic unit, which was based on trampoline jumps and coordination exercises, proved to be effective in improving the proficiency of the children attending the Teacch room.

Invited symposia

IS-SH06 HOW TO INTEGRATE PEDAGOGY OF HEALTH AND PHYSICAL EDUCATION FOR SCHOOL SUBJECT?

HOW TO INTEGRATE PEDAGOGY OF HEALTH AND PHYSICAL EDUCATION FOR SCHOOL SUBJECT?

YOSHINORI, O.

NIPPON SPORT SCIENCE UNIVERSITY

Globally, the name of the school subject related to health and physical education is quite different in each country. As a consequence, the subject signals that a teacher may be responsible for in teaching health education and physical education are the same, but on some occasions different teachers are responsible for discretely delivering each subject. Notions of health have therefore become a hot topic within the physical education profession. On the one hand, following the global crisis of Physical Education each country is fighting against reduced time allocation and seeking better agreement on the status of physical activity in school programs. In this process, the concept of physical education has differentiated into several concepts. In this nexus, health is increasingly valued as an important factor to advocate for quality physical education program. However, without appropriate pedagogy for the subject, it would be impossible to develop quality Health and Physical Education program in schools. Based on this concern, we set following questions and try to find our better answers to these topics;
1) How has health education been conceptualized and institutionalized into physical education in school programs across the globe?
2) What are the pedagogical implications for the integration of health education in school physical education programs?
3) How can physical education teacher education programs best prepare PE teachers to teach health education in schools?
The subjects related with physical activity and health in Japan are described as Physical Education in elementary school and Health and Physical Education in junior and senior high schools. Health is taught as the compulsory and independent subject content area in health and physical education. This means that the so called physical education teacher is not only the physical education teacher, but also the health education teacher. On the other hand, health is taught not only by the physical education teacher, but also by the classroom teacher in elementary school and also by the school nurse. In Japan, the discipline of pedagogy for physical education is established in the Japan Society of Physical Education, Health and Sport Sciences, but pedagogy for health education is not established. This means even though we have the subject health and physical education, we do not have any independent academic discipline of pedagogy for health until 2016 because these two societies are independent society in each other and now seeking to find better relationship between them. This does not constitute a good environment for improvement of quality of health and physical education because pedagogy would be critical for keeping quality of health and physical education teacher education program. On the other hand, gaps between the perceived quality of journals targeted to practitioners and researchers has been pointed out. Therefore, it is suggested to establish the pedagogy for health and physical education as one of the disciplines, as an immediate requirement.

HEALTH AND PHYSICAL EDUCATION FROM A EUROPEAN PERSPECTIVE

CLOES, M.

UNIVERSITY OF LIEGE

At the end of the 20th century, several authors pointed out that physical education (PE) was crossing a crisis. The emphasis on the fight against a growing sedentariness of the society became progressively one of the priorities of the national education leader all around the world. In many countries, PE teachers had to implement new approaches in order to teach to the youth how to adopt a healthy lifestyle. Pre- and in-service PE teachers' training started to propose programmes integrating health education in PE lessons while the reputation of the physical literacy concept spread quickly. Chin and Edginton (2014) invited scholars from 40 nationalities to describe the contemporary policies and practices of health and PE applied in their countries. Among those contributions, 23 concerned European countries.
In this presentation, we will propose an overview of the trends that can be identified in this sample of European nations. Preliminary analysis underlines that combination of PE and health education is distributed along a continuum. At one extremity, PE's input on health is not clearly expressed even if PE is expected to improve pupils and students' health through selected activities like endurance training. At the opposite extremity, countries emphasize the role of the PE teacher as a health educator and not only through a limited focus on PA promotion and on the preparation of physically educated citizens.
The second part of the paper will illustrate some actions that are undertaken in order to motivate the PE teachers to implement 'health enhanced physical activity' projects in their lessons. Such approaches respect principles associated with the concept of quality physical education (QPE). These PE classes should allow students to have positive individual and collective learning experiences where they develop knowledge, skills and dispositions that allow them to be autonomous and responsible decision makers relative to engagement in PA and sport in their lives (AIESEP, 2014). Following Haerens et al. (2011), it seems that a Pedagogical Model for Health-Based Physical Education should be developed in order to help PE teachers to leave their ingrained professional practices. They need to change their framework influenced by their athletic experience in order to integrate new teaching strategies. That starts by changing their representations on physical activity in a way to be able to explain it to the youths: Definition, Impact, Recommendations, Self-assessment, and Implementation. Action-research, development of communities of practice, pedagogical cases and demonstration of the students' interest for teaching approaches focusing on lifestyle aspects represent promising strategies to succeed in the process of changing the priorities.

EXPLORING THE IMPACT OF PUBLIC HEALTH AGENDAS IN PHYSICAL EDUCATION TEACHER EDUCATION: AN AUSTRALIAN PERSPECTIVE

MCCUAIG, L.

THE UNIVERSITY OF QUEENSLAND

Historically, concerns regarding the relationship between health education and physical education have tended to focus on matters of school curriculum. However, as the past two decades have witnessed a revival of public health as a pre-eminent remit of PE (Sallis & McKenzie, 1991), advocates have argued that contemporary Physical Education Teacher Education (PETE) programs are most effective when they are grounded in public health goals and health promotion theory (McKenzie & Lounsbery, 2013). From this perspective, McKenzie (2007) argues that PETE programs best prepare PE teachers when they focus on children's behavioral and psychological responses to exercise and physical activity, consider topics such as correlates of childhood physical activity, ecologic models explaining physical activity behavior and teach potential instructors how to develop student behavior-change skills, such as goal setting, self-monitoring, self-reinforcement, soliciting social support and resisting negative influences on physical activity and health (McKenzie, 2007). Notwithstanding this support, researchers and PETE educators have questioned this emphasis on obesity, individualism and modes of bodily surveillance (Gard & Wright, 2001, 2005). Additionally, health educators have questioned the narrow definition of health adopted by PETE educators, one that privileges diet and exercise over topics such as drug and alcohol use, relationships and sexual education, body image, mental health and food studies, to name but a few (Fetro, 2000; Leahy et al., 2015). As Tinning (2004) suggests, many students resist the delivery of such topics as this knowledge is not consistent with their preconceived notions of what a teacher of HPE should be.
This presentation does not attempt to establish a sense of who is right or wrong, but draws upon the Australian context to provide an overview of current debates and their implications for those preparing prospective PE teachers. Within this context I explore the manner in which public health "interventionist approaches" have the potential to compromise young people's positive engagement in school sport and physical education programs.

Oral presentations

OP-SH13 Athletic career

IDENTIFICATION OF WITHIN-CAREER CHALLENGES FOR DUTCH FEMALE GYMNASTS DURING DIFFERENT STAGES OF ATHLETIC DEVELOPMENT

BLIJLEVENS, S.1,2,3, WYLLEMAN, P.1,2, ELFERINK-GEMSER, M.T.3, VISSCHER, C.3, BOOL, K.2

*1: VUB (BRUSSEL, BELGIUM), 2: NOC*NSF (ARNHEM, NETHERLANDS), 3: RUG (GRONINGEN, NETHERLANDS)*

Introduction
During their athletic career athletes are confronted with challenges in different domains of development (e.g. athletic, psychological, psychosocial, educational, financial). There is a strong need to deepen the knowledge on the within-career challenges faced by talented and elite athletes (Wylleman & Rosier, 2016). Therefore, the purpose of our research was to identify within-career challenges gymnasts are confronted with during initiation, development and mastery stages of athletic development in training sessions, competition, and in daily life.
Methods
In-depth interviews were used to explore the challenges of 16 talented and elite gymnasts (M=16.5 years, SD=4.6 years) are recently confronted with. Gymnasts were divided into three groups, corresponding to the stage of athletic development (initiation, developmental and mastery stage) they were in. All gymnasts were seen as the highest potentials of their age.
Results

The results show differences in the challenges for the three different stages of athletic development. The number of quotations as well as the number of challenges increases as the gymnasts are older. Further, some challenges occurred in each stage of athletic development. Most mentioned challenges in the initiation stage were 'to learn new elements' and 'to do fearful elements' in training sessions. During the developmental stage, most mentioned challenges were to combine your athletic career with school. Although in the mastery stage the challenge 'to be limited in social contacts and activities' had the highest percentage, the highest number of challenges occurred during competition, as dealing with stress, distractions and adapt to other apparatus.
Discussion
The results offer insights in the differences in challenges gymnasts are confronted within specific stages of their athletic development. Some challenges especially occur in specific stages of athletic development, while other challenges occur in all stages of athletic development. These insights provide useful knowledge for people involved in talent development, as the effectiveness of coaching and counseling may be reduced if they are not appropriate to the developmental stage of the athlete (Knight & Holt, 2002). Future research should focus on the personal characteristics needed by talented and elite athletes to successful cope with challenges in different stages of athletic development.
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*Research funded by the Dutch Olympic Committee (NOC*NSF)
Contact
suzan.blijlevens@vub.ac.be

HELPING DUAL CAREER ATHLETES TO RECOVER FROM INJURY: A DUAL CAREER SUPPORT PROVIDERS' PERSPECTIVE

DEFRUYT, S.1, WYLLEMAN, P.1, DE BRANDT, K.1, STAMBULOVA, N.2, LINNÉR, L.2
1: VUB (BRUSSELS, BELGIUM), 2: HALMSTAD UNIVERSITY (HALMSTAD, SWEDEN)

Introduction
The combination of elite sport and study, called a dual career (DC), can be challenging for athletes. DC Athletes can encounter co-occurring challenges at different domains of development (athletic, psychological, psychosocial, educational/vocational and financial) (Wylleman & Lavallee, 2004). In this challenging period and environment, the burden of an injury is likely to be stressful for DC athletes. Although previous research have looked at how sports stakeholders can support the athletes within the athletic domain, no research up to our knowledge addressed how elite athletes can be supported holistically (i.e. in the different domains of development) outside of the club context. Therefore, current research aimed at gathering good practices of holistic support for DC athletes from a dual career support provider (DCSP) perspective.
Methods
Within the 'Gold in education and Elite Sport' (GEES) project, co-funded by the Erasmus+ Programme of the European Union, focus groups were conducted with a selection of DCSPs. As inclusion criterion for the participants, a DCSP was defined as: 'a professional consultant, related to an educational institute and/or an elite sport organization – or certified by one of those – that provides support to elite athletes in view of optimizing their DC (combination of elite sport and education).' One focus group in Sweden with six DCSPs and two focus groups in Belgium with two and three DCSPs were held. Using a phenomenological approach, participants were asked to share their methods used to holistically support DC athletes in coping with an injury.
Results
Five main themes of support emerged from the DCSPs discussions: a) practical support (e.g. support with transport problems if necessary), b) emotional support (e.g. empathic listening), c) reframing the injury in a holistic perspective (e.g. athletes will have more time for studies and family), d) empowerment of self-regulation competences (e.g. encourage the use of a recovery agenda), e) multidisciplinary and multi-organizations' cooperation (e.g. structural meetings between different DC stakeholders).
Conclusion
Findings underscore the importance of a developmental and empowering approach in holistically supporting DC athletes to recover from an injury. Moreover, the cooperation between stakeholders in a DC support environment is crucial for an optimal recovery. Future research and practice could use current findings to develop injury recovery programs in a DC setting.
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Contact.
simdefru@vub.ac.be

GOLD IN EDUCATION AND ELITE SPORT : WHICH COMPETENCES DO STUDENT-ATHLETES REQUIRE IN COPING WITH CHALLENGING DUAL CAREER SCENARIOS?

DE BRANDT, K.1, WYLLEMAN, P.1, DEFRUYT, S.1, TAELMAN, K.2
1: VRIJE UNIVERSITEIT BRUSSEL, 2: SPORT VLAANDEREN

Introduction
Recently, an increasing body of literature has researched the competences talented and elite athletes require in order to combine education and elite sport. However, most studies have approached athletes' dual career (DC) from a general perspective, lacking context specificity. Therefore, as part of the GEES Erasmus+ project, this study aimed to investigate the competences athletes require in order to cope with specific challenging DC scenarios.
Methods
The GEES consortium identified i) a GEES list of 38 dual career (DC) competence items and 4 underlying DC competence factors (DC management competences, Self-regulation & Resilience competences, Social competences, and Career Planning competences), and ii) 7 challenging DC scenarios (e.g. exam coincides with competition (1), making study choices (2), missing significant days of study (3), relocating for sport and/or study (4), suffering from an injury (5), social life expectations (6), financial issues (7)) (De Brandt et al., 2016). 878 17-to-26-year-old elite student-athletes (mean age 21.4 ± 2.2 yrs; 52% female) from 9 countries (Belgium, France, Italy, the Netherlands, Po-

land, Slovenia, Spain, Sweden, the UK) indicated if they had experienced and how well they managed the 7 scenarios, and selected from the GEES list the five competences they perceived as most important to successfully manage each scenario.
Results
74% of student-athletes experienced at least 4 of 7 scenarios. Scenario 6 was experienced by 87% of student-athletes, followed by scenario 3 (84%), scenario 1 (79%), scenario 2 (75%), scenario 4 (73%), scenario 5 (57%), and scenario 7 (29%). Athletes reported to cope best with scenario 4 and the worst with scenario 7. In terms of scenario-specific coping, athletes prioritized their DC management competences (e.g. efficient use of time) in scenario 1, 3, 6 and 2. Self-regulation and resilience competences (e.g. using setbacks as a positive stimulus) were perceived most important in scenario 5, 1, 2 and 7, where prioritizing social competences (e.g. asking advice to the right people) was important in scenario 6, 4 and 5. Career planning competences (e.g. exploring career plans outside of elite sport) were perceived most important in scenario 2, 7 and 5.
Discussion
Findings imply that a need exists for complementing the developmental and holistic approach with a situational approach when assisting athletes during their DC 'elite sport and study'.
References
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RELATIONSHIP BETWEEN EMOTIONAL INTELLIGENCE AND SELF-EFFICACY AMONG ELITE YOUNG ATHLETES

KNISEL, E., STUCKE, C.
OTTO-VON-GUERICKE UNIVERSITY OF MAGDEBURG

Introduction
Research in sport psychology has emphasized that emotional intelligence correlates with sport performance (Crombie, Lombard & Noakes, 2009; Lane et. al, 2010; Zizzi, Deaner & Hirschhorn, 2010). In their review Laborde, Dosseville and Allen (2016) found that emotional intelligence relates to competition day emotions, physiological stress responses, effective psychological skill usage, and more successful athletic performance. Emotional intelligence encompasses the perception, facilitating, understanding and managing of emotions (Mayer, Caruso & Salovey, 1999). Thus, emotional intelligence is viewed as a set of competencies and the study investigate the correspondence with the athletes' belief in these competencies.
Methods
Relationships between trait emotional intelligence and general self-efficacy expectations were investigated. 330 athletes of the Olympic Centre Sachsen-Anhalt (120 female athletes and 210 male athletes) aged between 13 and 24 (M=15.4; SD=1.47) completed the self-report measure of emotional intelligence (BarOn Emotional Quotient Inventory, Youth Version; Bar-On, 2000) and the self-report measure of general self-efficacy expectations (Schwarzer, 2002). Pearson correlation coefficient was used to investigate relationships between the variables followed by multivariate regression analyses to predict general self-efficacy expectations using emotional intelligence components as predictors.
Results
The results demonstrated a significant relationship between all components of emotional intelligence and athletes' self-efficacy expectations ($r=.522$; $p<.01$). Emotional intelligence correlated with general self-efficacy beliefs in both female and male athletes, and in all age groups (13-15, 16-18 and over 19 years). Regression analysis showed that stress management ($\beta=.124$, $p=.006$), adaptability ($\beta=.430$, $p=.000$) and general mood ($\beta=.283$, $p=.000$) were significant predictors for athletes' self-efficacy expectations. For the female athletes the significant predictors for self-efficacy were adaptability and general mood. However, when the different age groups were separately analysed, adaptability significantly predicts young adults' self-efficacy beliefs while general mood was shown to be a significant predictor in the age group 16-18 years.
Discussion
The results underline that self-efficacy beliefs were significantly predicted by some components of emotional intelligence. For applied sport psychology the interaction of specific components of emotional intelligence and general self-efficacy expectations is an important topic. If different profiles of emotional intelligence correspond with high self-efficacy, interventions are needed to improve elite young athletes' emotional intelligence as it relates to self-efficacy expectations and performance.

EMOTIONAL STATES ASSOCIATED WITH BEST PERFORMANCE; RESULTS FROM A LARGE ONLINE STUDY

LANE, A., TOTTERDELL, P., DEVONPORT, T., FRIESEN, A., BEEDIE, C., TERRY, P.
UNIVERSITY OF WOLVERHAMPTON

Introduction
It is commonly known that performance under pressure associates with intense emotions and regulating these emotions forms a key part of mental preparation (Hanin, 2010). It appears athletes are able to identify an optimal mindset for performance and this optimal emotional state guide emotion regulation. Using data from the BBC LabUK project (Lane, Totterdell, McDonald et al., 2016), we investigate emotional states associated with best performance. We argue that knowledge of emotional states associated with best performance has theoretical and practical value.
Methods
Data were collected online via the BBC Lab UK website (Lane et al., 2016). Data collection involved participants being asked to reflect on how they felt before competing in a competitive performance considered their best. Participants (N = 74,204) completed a brief version of the Sport Emotion Questionnaire (Jones, Lane, Bray, Uphill & Catlin, 2005) to assess "Happy", "Anxious", "Dejected", "Energetic", "Fatigued", "Angry", and "Excited", with two additional items ("Fatigued") and ("Energetic") included to reflect arousal.
Results
Cluster Analysis on emotional responses associated with best performance produced 4 clusters. MANOVA of cluster membership indicated significant differences best each emotional profile (Wilks lambda 21,211656 = .10, $p < .0001$; Partial Eta2 = .53). Results indicated significant differences in emotions between each emotion and each group. Cluster 1 contained 11,637 participants and was characterised by feeling high scores for happy, energetic, excited, and low scores for anxiety, anger and dejection. Cluster 2 contained 26,769 participants with participants reporting high scores for happy, excited, energetic, moderate scores for anxiety and very low scores for angry and dejected. Cluster 3 comprised 9,817 participants and characterised by reporting moderate scores for anxiety, energetic, excited and happy and low but noticeable scores for dejection and anger. Cluster 4 comprised 20,497 participants and was characterised by feeling happy, excited, and energetic with moderate scores on intense anxiety.

Discussion
Results of the present study indicate that there are multiple different emotional states associated with best performance. In competitive settings, a wealth of support has shown that supposedly unpleasant emotions such as anger and anxiety can be perceived as helpful, a suggestion consistent with findings from the present study. We suggest that findings of the present could act as a guide to interpreting emotional profiles associated with successful performance but we encourage practitioners to pursue individual profiles of emotions believed to help perform.
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Contact
A.M.Lane2@wlv.ac.uk

Oral presentations

OP-PM70 Respiration and oxygen uptake

ELEVATED BASELINE WORK RATE SLOWS PULMONARY OXYGEN UPTAKE KINETICS AND DECREASES CRITICAL POWER DURING UPRIGHT CYCLING

GOULDING, R., ROCHE, D.M., MARWOOD, S.
LIVERPOOL HOPE UNIVERSITY

Introduction
Critical power (CP) is a fundamental parameter in defining severe-intensity exercise tolerance; however, its physiological determinants are unclear. CP has been shown to correlate with the phase II time constant (τ) of oxygen uptake (VO2) kinetics (Murgatroyd et al. 2011). Alternatively, CP may be primarily dependent upon O2 availability in the exercising musculature (Broxterman et al. 2015). Initiating exercise from an elevated baseline work rate in the upright position slows τ independently of any alterations in O2 availability (DiMenna et al. 2008). Therefore, we hypothesised that if τ is an independent determinant of CP during upright cycling, CP would be expected to be lower when exercise is initiated from an elevated baseline work rate compared to when exercise is initiated from unloaded cycling.
Methods
7 healthy men completed an incremental ramp test to determine VO2 max and the gas exchange threshold (GET). This was followed by 8 visits whereby CP, pulmonary VO2, muscle deoxyhaemoglobin ([HHb]; via near-infrared spectroscopy) kinetics and absolute concentrations of oxyhaemoglobin ([HbO2]), were determined via 4 severe-intensity constant load exercise tests to exhaustion in two conditions: 1) exercise initiated from an unloaded baseline (U>S) and 2) exercise initiated from a moderate-intensity baseline at 90% GET (M>S).
Results
In M>S, CP was lower (U>S: 213 ± 45 vs. M>S: 203 ± 44 W; P = 0.011), and τ was slower (U>S: 34 ± 16 vs. M>S: 51 ± 14 s; P = 0.002) when compared to U>S. Additionally, [HbO2] during exercise was greater (U>S: 38.9 ± 8.6 vs. M>S: 43.4 ± 10.6 μM; P = 0.031) and [HHb] kinetics were slower in M>S versus U>S (U>S: 14 ± 7 vs. M>S: 28 ± 7 s; P = 0.007).
Discussion
This study provides novel experimental evidence that VO2 kinetics are a determinant of CP during upright cycling. Initiating exercise from a moderate baseline resulted in a concomitant reduction in CP and slowing of VO2 kinetics when compared to a baseline of unloaded cycling. That [HbO2] was greater and [HHb] kinetics were slower when exercise was initiated from a moderate baseline compared to an unloaded baseline, suggests that O2 availability was not impaired in M>S. Therefore, the slowing of VO2 kinetics and subsequent reduction in CP observed in this condition were not related to inadequate O2 availability. These findings therefore demonstrate that τ is an independent determinant of CP during upright cycling.
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THE VO2 PLATEAU IS RELATED TO OXYGEN DEFICIT AND OXYGEN KINETICS

NIEMEYER, M., BENEKE, R.
PHILIPPS-UNIVERSITY MARBURG

Introduction
The plateau of oxygen uptake (VO2) at the end of an incremental exercise has been assumed to be related to the anaerobic capacity. This is based on the assumption that a higher anaerobic capacity allows for a later incremental test termination in relationship to the achievement of maximum oxygen uptake (VO2max). However, studies on interrelationships between the occurrence of a VO2 plateau and parameter/measurements of anaerobic capacity showed inconsistent results. This is potentially caused by differences in the accumulated oxygen deficit at the submaximal intensity domain of an incremental exercise depending on the time constant of VO2 kinetics. Therefore, we tested the hypothesis that the VO2 plateau occurrence in continuous incremental exercise depends on the accumulated VO2 deficit and VO2 kinetics.
Methods
Twenty-four physically active male students (mean ± SD age: 26.6 ± 3.6 years; body height: 183.4 ± 6.6 cm; body mass: 80.5 ± 7.7 kg) performed an incremental ramp test with a fixed ramp slope (30 W*min-1) on the first testing day. Subsequently on separate days they performed an incremental ramp test with an individualized ramp slope (leading to test termination within 8-9 min), a VO2max verification test (constant load exercise at 90% of maximum power of the first ramp test) and an extended-step incremental exercise test consisting of three constant load exercises, each with a duration of 6 min, and a step load of 50 W (step 1), workload at the gas exchange threshold (GET) (step 2) and 50% of the differences between GET and maximum power (step 3) of the first incremental ramp test. VO2 deficit was calculated from the differences between ramp VO2 and steady-state VO2 plus O2-lactate equivalent of the extended-step exercise. VO2

kinetics were calculated by linear (ramp kinetics) and exponential (step kinetics) regression analyses. A VO2 plateau was assumed if the increase in VO2 during the last 40 W was < 3 ml*W-1.
Results
Ten of the 24 subjects showed a VO2 plateau in the individualized ramp test. There were no significant differences in VO2max (3.99 ± 0.51 vs. 4.12 ± 0.34 l*min-1), Pmax (390.3 ± 55.7 vs. 383.0 ± 39.8 W) and maximum blood lactate concentration (14.3 ± 1.8 vs. 13.6 ± 1.4 mmol*l-1) between the plateau and the non-plateau group. However, 2 min before ramp test termination the accumulated VO2 deficit (2.3 ± 0.6 vs. 2.9 ± 0.5 l), ramp test mean response time (43.3 ± 8.6 vs. 52.8 ± 7.1 s), step test overall time constant of step 2 (36.1 ± 5.5 vs. 47.8 ± 6.8 s) and step 3 (61.7 ± 8.5 vs. 85.8 ± 9.9 s) were significantly lower (all $p < 0.05$) in the plateau group.
Discussion
The results of our study indicate that in subjects with a given VO2max and maximum blood lactate concentration the VO2 plateau phenomenon depends on accumulating oxygen deficit and thus on faster time constants of the VO2 kinetics.

THREE WEEKS EXPOSURE TO AIR POLLUTION AND ITS INFLUENCE ON LUNG FUNCTION OF WHEELCHAIR ELITE ATHLETES

PERRET, C., LEUPPI, J., MICHEL, F., STRUPLER, M.

INSTITUTE OF SPORTS MEDICINE AND SWISS PARAPLEGIC CENTRE NOTTWIL

Introduction
Beijing is among the most air polluted megacities in the world. Based on this fact, many experts warned of decreased athletic performance and serious health problems in view of the Olympic and Paralympic Games 2008. Amongst other health problems, difficulties in breathing, respiratory discomfort, airway irritation, asthma like symptoms and a reduced forced expiratory volume in one second (FEV1) were expected to appear during competitions under bad air quality. Due to reduced lung function and restricted pulmonary capacity during physical activity wheelchair athletes seem to be even more prone to develop respiratory complications under bad air conditions, which possibly lead to a severe decrease in athletic performance. The aim of the present investigation was to assess possible effects of the expected air pollution on lung function of Swiss elite wheelchair athletes participating at the Paralympic Games 2008 in Beijing.
Methods
Forced vital capacity (FVC), FEV1 and peak expiratory flow (PEF) were determined during the medical examination at home (pre-test) as well as during the first (post-test 1) and the third week (post-test 2) after the arrival at the Paralympic Village. Concomitantly concentration of particulate matters (PM10) was measured during the whole stay in Beijing.
Results
Post-test lung function measurements where performed 4.1±1.6 days and 16.7±0.5 days after arrival at the Paralympic Village. Analysis of variance revealed no differences concerning pre- and post-test lung function measurements. Average daily concentration of PM10 ranged between 22 and 119 µg/m3. No significant correlations were found between PM10 concentrations and lung function measurements.
Discussion
Although quite high at some days, air pollution was less than suspected in advance of the Paralympic Games 2008 presumably due to restrictive sanctions (reduced traffic, closing down of factories) of the organising committee. The measured PM10 concentrations seemed to have no effect on lung function as none of the athletes showed any respiratory complications or decreased lung function during the three weeks stay at the Paralympic Village.

18:00 - 19:30

Invited symposia

IS-PM07 THE INDIVIDUAL HUMAN PHENOTYPE - EFFECTS OF GENETICS, EPIGENETICS, EXERCISE AND NUTRITION

GENETIC ASPECTS

WOLFARTH, B.

HUMBOLDT UNIVERSITY / CHARITÉ UNIVERSITYMEDICINE

A body of literature indicates that genes play an important role in the determination of performance. In early publications, family studies showed a significant familial aggregation for e.g. endurance measures like maximal oxygen uptake (VO2max), with heritability levels up to 50% (Bouchard et al. 1986). In addition, twin studies suggested that the heritability could even be higher (Maes et al. 1996). For trainability levels of different endurance performance phenotypes a wide range of increase from about 5 60% of the initial level is described (Bouchard et al. 1998). There is no doubt that genes are involved and account for differences in baseline as well as trainability levels of performance traits. Progress in molecular genetic techniques gave us molecular markers to seek specific genes and polymorphic variations and to determine their implications for endurance and other performance related phenotypes.
The major aim of this review is to conclude the current status of science with a specific focus on different types of genetic markers in conjunction with performance phenotypes. The idea is to summarize the important findings thus far. The review will focus on the genes and markers that were found to be significantly associated with performance and were either replicated in independent studies or were generated from large, robust cohorts. Finally, the review will include a future perspective on that topic. The impact of genetic research in this field is likely to be significant as it should provide new insights into the physiology and pathways responsible for extraordinary performance achievements and trainability of individuals. It can make major contributions to understand the physiological basis for performance and training response patterns in humans.
In addition, such findings will have practical implications in several associated fields including promising directions, such as the medical benefits of exercise in the context of preventive and rehabilitative medicine.

INDIVIDUAL RESPONSES TO RESISTANCE TYPE EXERCISE TRAINING

VAN LOON, L.
MAASTRICHT UNIVERSITY MEDICAL CENTRE

Aging is associated with a progressive decline in skeletal muscle mass, strength, and physical function, a condition termed sarcopenia. Resistance-type exercise training currently represents the primary therapeutic strategy recommended to prevent and reverse the age-related decline in skeletal muscle mass, strength, and function. Previous work has shown substantial interindividual variability in resistance-type exercise- mediated changes in muscle mass and strength after a period of standardized exercise training. This has resulted in suggestions that some people may be unresponsive to the benefits of exercise interventions. We recently assessed the proposed prevalence of unresponsiveness of older men and women to augment lean body mass, muscle fiber size, muscle strength, and/or physical function following prolonged resistance-type exercise training in an older population. Though a large heterogeneity was apparent in the adaptive response to prolonged resistance-type exercise training when changes in lean body mass, muscle fiber size, strength, and physical function were assessed in older men and women, there was not a single subject that did not show a benefit on one or more of the assessed parameters. We conclude that there are no nonresponders to the benefits of resistance-type exercise training. Consequently, resistance-type exercise should be promoted without restriction to support healthy aging in the older population.

EPIGENTIC ASPECTS

BLOCH, W.
GERMAN SPORT UNIVERSITY

Epigenetics is one of the hot topic research fields in human science disciplines. Evidence suggests that modifications of the chromatin (e.g. histone modifications and DNA-methylation) as well as the expression of micro RNA molecules play a crucial role in the pathogenesis of several diseases. These mechanisms are involved in the development and maintenance of physical performance by epigenetic modifications of smooth muscle cell-, cardiomyocyte- and endothelial progenitor cell proliferation/differentiation, muscle fibers, satellite cells as well as cells involved in extracellular matrix processing, inflammation and endothelial function (e.g. endothelial nitric oxide synthase regulation). Besides other lifestyle factors, physical activity and sports essentially contribute to health, physical performance and regeneration.
It will be focused on recent research proposing physical activity as a potent epigenetic regulator in tissue and organs with consequence for function, adaption and regeneration. Especially the modifications of the chromatin by histone modifications and DNA-methylation by physical activity are focused. The sparse knowledge of physical exercise induced modulation in different cells types associated to performance and health will be discussed.
More knowledge about the molecular mechanisms and dose-response relationships of exercise are needed to understand the role of epigenetic modulation for performance and health by physical exercise programs.

Invited symposia

IS-PM13 Macro and micro vascular dysfunction: adaptations to exercise training

UNDERSTANDING THE CARDIOPROTECTIVE BENEFITS OF EXERCISE TRAINING: ROLE OF HEMODYNAMICS

THIJSSEN, D.
RADBOUD UNIVERSITY NIJMEGEN MEDICAL CENTRE

Exercise training has strong cardioprotective effects which, at least partly, are mediated through improvement in vascular function and structure. It is assumed that adaptation in conduit arteries impact upon atherosclerotic plaque burden, whilst large and small resistance vessels affect blood pressure control and microvascular complications. Together, these adaptations improve cardiovascular risk. To better understand these adaptations, this lecture will provide a state-of-the-art overview of the literature related to the direct impacts of hemodynamic forces on the vasculature. Specifically, this lecture aims to understand the impact of shear stress, the dragging force of blood acting upon the vascular wall. Several studies have demonstrated that a bout of exercise acutely influence blood flow and luminal shear stress. Evidence, from both animal and human work, is presented to demonstrate the key role of shear stress to mediate adaptations in vascular function and structure. Furthermore, differences between different types of exercise, but also between-group differences, will be discussed. Finally, the impact of shear stress as a stimulus to induce changes in arterial function, size, wall thickness will be linked to changes in health and cardiovascular risk.

EXERCISE TRAINING: INTERVAL EXERCISE, SHEAR AND PROGENITOR CELLS

BIRCH, K.
UNIVERSITY OF LEEDS

The cardioprotective effects of exercise training for healthy individuals and those with atherosclerosis include the mobilisation of progenitor cells thought to aid in vascular repair. These cells can be released from the bone marrow or the vascular wall in response to exercise induced changes in the metabolic environment or vascular frictional force (shear). Research has traditionally assessed adaptations to moderate intensity continuous exercise, however more recently there has been a great interest in the impact of higher intensity exercise performed in intervals. In comparing these types of exercise both the metabolic environment and the shear stress applied to the vascular walls differ in magnitude and pattern. To better understand the impact of these differences upon the vascular wall this lecture will provide a state-of-the-art overview of the literature related to exercise and endothelial related progenitor cells. Specifically, this lecture aims to understand how varying the metabolic demand and/or the shear stress patterns associated with moderate intensity continuous and heavy/high intensity interval exercise impact (i) mobilisation of progenitor cells and (ii) the function of these cells. Evidence from human and animal studies is presented to demonstrate the importance of exercise in vascular repair mechanisms. The impact of these mechanisms for both health and cardiovascular disease will also be discussed.

MICROVASCULAR ADAPTATION TO EXERCISE IN HEALTH AND DISEASE

HELLSTEN, Y, HOIER, B.

UNIVERSITY OF COPENHAGEN

A well-functioning microcirculation in skeletal muscle is essential for maintenance of normal blood pressure, for adequate delivery of oxygen and nutrients to the tissue and for optimal muscle function. In life style related disease, the microcirculatory function is impaired, in part due to an reduced ability of the vascular endothelial cells (endothelial dysfunction) to form compounds that regulate the blood vessel tone, promote growth of new microvessels and maintain general microvascular health. Severe endothelial dysfunction at the microvascular level markedly increases the risk of cardiovascular events such as stroke and myocardial infarction and effective interventions to improve endothelial function in individuals at risk are clearly important. One of the most effective interventions to improve microvascular endothelial function and enhance microvascular growth is regular physical activity. This lecture emphasizes the impact of life style related disease on microvascular function and structure and addresses how physical activity improves microvascular endothelial health and growth of microvessels. Focus will also be on new insights into the mechanical and molecular mechanisms that underlie the beneficial effects of exercise on the muscle microvasculature in lifestyle related disease.

Oral presentations

OP-PM51 Nutritional status and analysis

DIETARY SUPPLEMENT USE, IMPACT ON MICRONUTRIENT INTAKE OF YOUNG ELITE GERMAN ATHLETES

BRAUN H.1,2, VON ANDRIAN-WERBURG, J.1,2, MAY S.2, GEYER H.1, SCHAENZER W.1, THEVIS M.1,2,3

GERMAN SPORT UNIVERSITY COLOGNE, COLOGNE, GERMANY

Introduction
It is widely accepted, that the use of Dietary Supplements (DS) does not compensate for an inadequate diet and DS use in young athletes should be discouraged (Desbrow et al. 2014). Nevertheless, the prevalence of DS use in young athletes is high (Braun et al. 2009). However, little is known about dosage and nutrient intake from DS. Therefore, we evaluated dietary intake, DS use and its impact on total nutrient intake of young elite athletes.
Methods
For this study we evaluated dietary data of 122 young elite athletes (12-18 yrs), using a validated 7-d food and activity record (Koehler et al. 2010). Micronutrient intake (13 vitamins, 11 minerals) was estimated based on the German food database (BLS II.3) using Ebispro Software, with respect to the age related RDAs. Athletes specified all DS (e.g. company name, dosage pattern, frequency of use) used within the 7 days of food recording. Each DS was included into the food database to evaluate the diet with and without DS use.
Results
We found 39 athletes (32%) using 45 different DS, mainly products including a mixture of multi-vitamins (n=5), multi-minerals (n=15) or a combination of both (n=17). Magnesium (69%), vitamin C (64%), zinc (56%), vitamin B6 (56%), vitamin B12 (46%) are the nutrients, taken mostly. In 358 (38%) nutrient-data (ND) out of 936 (=24 nutrients x 39 athletes) athletes reported dietary micronutrient intakes below the RDAs. DS use increased ND in 323 cases. In 222 cases (69%) the RDAs were already met through dietary intake, while 16% (n=51) did not increase micronutrient intake sufficiently to attain the respective RDA. Hence, only 15% (n=50) of the nutrients were increased adequately by the use of DS in order to reach the RDAs.
Discussion
In the present study, dietary intake of young athletes did not meet the RDA for selected micronutrients. Supplementation with vitamins and minerals did increase micronutrient intake (> 100% RDA) only for few nutrients, while most of the DS did not contribute to a micronutrient balance, with respect to the age related RDA levels. Therefore, we suggest that young athletes need more information on optimizing their diet, but also more information on a wise use of dietary supplements.
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Contact
h.braun@dshs-koeln.de

NUTRITIONAL INTAKE IN ELITE CROSS-COUNTRY SKIERS DURING A SIMULATED SPRINT RACE

CARR, A.1,2, MELIN, A.3, GOVUS, A.1, ANDERSSON, E.1, SHANNON, O.4, PROVIS, H.1, KARLSSON, M.1, MATTSON, S.5, MCGAWLEY, K.1

1: SWEDISH WINTER SPORTS RESEARCH CENTRE (SWEDEN), 2: DEAKIN UNIVERSITY (AUSTRALIA), 3: UNIVERSITY OF COPENHAGEN (DENMARK), 4: LEEDS BECKETT UNIVERSITY (UK), 5: SWEDISH OLYMPIC COMMITTEE (SWEDEN).

Introduction
Habitual nutritional intakes in cross-country skiers have previously been reported (Fogelholm et al., 1992), however in elite cross-country skiers there is limited knowledge about race-specific nutritional practices, or the prevalence of dehydration and persistent low energy availability (EA). This study aimed to investigate, in the context of a simulated sprint race, energy intake, macronutrient intake, hydration status and the risk of persistent low EA in elite cross-country skiers.
Methods
Thirty-two male (n = 18) and female (n = 14) elite Swedish cross-country skiers completed weighed food records the day prior to (day 1) and the day of a simulated sprint race (day 2); the food records were analysed for energy (kcal/kg), macronutrient (g/kg) and fluid intake (L). Urine specific gravity (USG) was also measured on day 1 and day 2. The risk for persistent low EA was assessed in the female skiers using the Low Energy Availability in Females Questionnaire (LEAF-Q; Melin et al., 2014). Results were analysed using a three-way mixed ANOVA. Statistical significance was set to a level of $p \leq 0.05$.
Results

Males had a higher energy intake (65±9 kcal/kg) on day 1, (pre-race) compared with day 2 (simulated sprint race; 58±9kcal/kg; p = 0.002). Females consumed 57±10 kcal/kg on day 1, which was similar to their day 2 energy intake (54±6 kcal on day 2; p > 0.05). Males consumed less carbohydrate (8.2±2.3g/kg) on day 1 compared with day 2 (8.9±2.3g/kg) (p = 0.026), as did females, consuming 7.0±1.5g/kg on day 1, and 8.4±1.7g/kg on day 2 (p = 0.003). There were similar fluid intakes across the two days for males (p > 0.05) and females (p > 0.05). Nine of the 18 males and 6 of the 14 females were dehydrated (USG > 1.020) on day 1, and 9 males and 5 females were dehydrated on day 2. Five of the 14 females were classified as being at risk of persistent low EA.
Discussion
This study provides an initial insight into nutritional competition habits in elite cross-country skiers. The findings indicate that elite skiers' nutritional intakes are consistent with guidelines, particularly those for endurance athletes' carbohydrate intake for competitive events (Burke et al., 2001). There was however some evidence of persistent low EA and dehydration, suggesting additional considerations that may be relevant to cross-country skiers' nutritional intakes for sprint races.
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NUTRITION STATUS OF YOUNG FEMALE ELITE GERMAN FOOTBALL PLAYERS

VON ANDRIAN-WERBURG, J.1,2, BRAUN, H.1,2, SCHAENZER, W.1, THEVIS, M.1,2,3
GERMAN SPORT UNIVERSITY COLOGNE, COLOGNE, GERMANY

Introduction
Young female athletes often face the challenge to meet the recommended nutrient and energy intake for sports performance, growth, and development. The purpose of this study was to investigate the nutritional status of young female elite football players using a 7-day food record in parallel with a 7-day activity record.
Methods
A total of 56 young female elite football players (14.8±0.68 yrs) completed the validated food and activity protocols (Koehler et al. 2010). Misreporting was assessed by the ratio of energy intake to energy expenditure and misreported protocols were excluded from analysis (Black 2000). The food records were analyzed concerning energy, macronutrient and micronutrient intake and energy expenditure was calculated using predictive equations. Hematological data and 25-hydrodxyvitamin-D serum concentrations were measured from venous blood samples.
Results
Mean energy intake was 2226±368 kcal/d (40.5±7.0 kcal/kg/d) and estimated energy expenditure averaged 2403±195 kcal/d. 53% of the players exhibited an energy availability <30 kcal/kg lean body mass. 31% of the athletes consumed <5g/kg carbohydrates and 34% consumed less than 1.2 g/kg protein. A large proportion of players (%) had intakes below the RDA of folate (75%), vitamin D (100%), iron (69%) and calcium (59%). Ferritin and 25-OH-D serum levels were below recommendations of 59% and 38%, respectively.
Discussion
A remarkable number of players failed to meet energy balance and suggested recommended carbohydrate and protein intake (Burke 2011, Desbrow 2014). Low iron and 25-OH-D serum levels were observed elucidating a suboptimal nutrition status of some young female football players. As a consequence, strategies have to be developed for a better information and application of sport nutrition practice among young female football players.
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Contact
j.andrian@biochem.dshs-koeln.de

ENERGY EXPENDITURE AND FOOD INTAKE OF PROFESSIONAL FOOTBALL PLAYERS IN THE DUTCH PREMIER LEAGUE: IMPLICATIONS FOR NUTRITIONAL COUNSELING

BRINKMANS, N.Y.J., IEDEMA, N., PLASQUI, G., SARIS, W.H.M., VAN LOON, L.J.C., VAN DIJK, J.W.
HAN UNIVERSITY OF APPLIED SCIENCES, MAASTRICHT UNIVERSITY MEDICAL CENTRE

Introduction
Selecting appropriate dietary strategies and optimizing the diet for professional football players requires detailed information on their energy expenditure and dietary intake. So far, information on energy requirements and dietary intake of football players is limited to small cohorts or amateurs. The aim of this study was to determine the energy expenditure and dietary intake in a representative sample of professional football players.
Methods
A total of 41 professional football players (age 23±4 y, height 1.82±0.06 m, bodyweight 77.6±8.0 kg) from three football teams playing in the Dutch premier league (Eredivisie) participated in this observational study. Energy expenditure (EE) was determined over a 14-day period by the doubly labeled water method (DLW). Dietary intake was assessed by three face-to-face 24h recalls, including a match, training, and rest day. Dietary intake was processed by Compl-eat™ software, and analyzed for energy and macronutrient intake. Comparisons between match, training, and rest days were made by repeated measures ANOVA. Data are reported as means±SD.
Results
The 14-day period contained 2.3±0.5 match, 8.7±1.0 training and 3.1±1.0 rest days. The mean daily EE assessed over the 14-day period was 13.7±1.5 MJ/day (178±41 kJ/kg bodyweight), and correlated well with bodyweight (r=0.68; p<0.001). The weighed mean energy intake (EI) was 11.1±2.9 MJ/day, indicating 18±15% underreporting of EI. The daily EI was higher on match days (13.1±4.1 MJ) compared with training (11.1±3.4 MJ; p<0.01) and rest days (10.5±3.1 MJ; p<0.001). In agreement, daily carbohydrate intake was significantly higher during match days (5.1±1.7 g/kg bodyweight) compared with training (3.9±1.5 g/kg bodyweight; P<0.001) and rest days (3.7±1.4 g/kg bodyweight; p<0.001). The daily protein intake on match, training, and rest days was 1.8±0.6, 1.7±0.6 and 1.5±0.5 g/kg bodyweight,

respectively. The distribution of protein intake over the day was quite skewed, with the lowest intakes reported at breakfast and highest intakes at dinner.
Discussion
The daily energy requirements of professional football players are modest, with an average daily energy requirement of ~13.8 MJ (178 kJ/kg bodyweight). The daily intake of carbohydrates is below the general recommendations for football players and should be increased to maximize performance and recovery. Daily protein intake seems to be adequate according to the recommendations, but should be distributed more evenly throughout the day.

THE HORSERACING INDUSTRY'S PERCEPTION OF JOCKEY NUTRITION AND WEIGHT-MAKING

MARTIN, D., WILSON, G., MORTON, J.P., CLOSE, G.L., MURPHY, R.C.
LIVERPOOL JOHN MOORES UNIVERSITY

Introduction
Adherence to high protein, low glycaemic-index carbohydrate diets can facilitate significant fat loss whilst maintaining lean tissue and improving performance markers in jockeys (Wilson et al., 2015). Despite the presence of effective strategies, a reliance on archaic practices exists (Dolan et al., 2011). No previous attempts have investigated the cultural assumptions of the horseracing industry and why, despite a growing base of safe and optimal practices, the outdated and compromising methods are still widely maintained. This study aimed to explore the perspectives of the horseracing industry to determine its perception of jockeys and the influences on nutrition.
Methods
Semi-structured interviews were conducted with professional jockeys (n=10), racecourse clerks (n=7), jockey agents (n=2), racehorse trainers (n=3), and jockey coaches (n=4). All interviews were transcribed verbatim and uploaded to software NVivo10 to facilitate a six-stage process of thematic analysis.
Results
Results were split into categories of a) jockeys' perceptions and b) support networks' perceptions of influences on nutrition practice. Nine higher order themes made of three general dimensions embodied the jockeys' perceptions (cultural weight-making: dehydration, disordered eating; individual influences: reluctance to change, athletic identity, denial and bargaining, horse is the athlete; social influences: peers and trainers, nutrition support teams, racecourse food). Ten higher order themes within five general dimensions emerged from the support network (influence of trainers: outward facing, cultural reluctance; influence of agents: family-like support, too much control; influence of coaches: more than a coach; athletic identity: promote athletic identity, lack of recognition; industry education: start of career education, use of role models, education for all industry).
Discussion
An industry-wide awareness of archaic practices exists. There is widespread contention over the athletic identity of jockeys, with a focus of the horse being the athlete. This outlook inhibits the development of professional athlete tendencies. Furthermore, jockeys' support network including trainers, agents and racecourses may significantly influence the nutrition practices of jockeys. The underpinning factor may be the systemic lack of nutrition education across the whole industry and work towards the development of an industry-specific education platform is recommended.
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Contact
d.martin@2015.ljmu.ac.uk

A COMPARISON OF DIETARY ASSESSMENT METHODS WITHIN ELITE YOUTH SOCCER PLAYERS: A PLACE FOR NEW TECHNOLOGY?

NAUGHTON, R.J., ANDY O'BOYLE, A., DRUST, B., MAHON, E., ABAYOMI, J., MORTON, J.P., DAVIES, I.G.
UNIVERSITY OF HUDDERSFIELD

Introduction
Within the literature that has analysed elite youth soccer players' dietary habits, under-reporting is described almost universally (Naughton et al., 2016). This is of concern as inaccurate dietary data may consequently result in researchers making flawed conclusions leading to practitioners giving wrongful advice. Recent advances in the use of smartphone (SP) technology as a tool to record dietary data has grown in popularity (Jospe, Fairbairn, Green, & Perry, 2015), however, no research has been conducted within an elite youth soccer setting, assessing if SP methods are viable in this population.
Methods
To investigate, fulltime players from an English Premier League academy (aged 18±1 years; n =22) recorded their dietary intake via a SP app, and by remote photography methodology (RPM) using their SP on a single training day. The following day participants completed a 24-hr recall, with the obtained data used to compare against the data collected from the SP methodologies.
Results
Results shown that compliance when reporting main meals (breakfast, lunch, & dinner) using the SP methods was >70%, although for snacks (afternoon & pre-bed) this dropped to 36.4% when using the app, and 18.2 % for RPM. Furthermore, we found that the 24-hr recall presented with significantly higher mean total energy (2383.2±598.5 vs 1638.1±858.2 & 1785.2±569.4 kcal), carbohydrate (257.7±94.2 vs 168.1±98.4 & 177.6±71.2 g) and protein (169.0±39.5 vs 122.3±34.9 & 131.1±36.9 g) intakes than both the app and RPM, respectively ($p < 0.05$), which is unsurprising given the low compliance for snacks.
Discussion
The reported intakes from the 24-hr recall are comparable with previous findings from our group within a similar population. In conclusion, it appears that there may be a use of SP technology to collect dietary data within applied youth soccer settings, particularly for main meals. However, due to the apparent low compliance when reporting snacks it may be advisable to use a more traditional methodology, such as the 24-hr recall, to support any SP methods.
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Contact
R.Naughton@hud.ac.uk

Invited symposia

IS-BN01 SPECIFICITY OF BALANCE AND BALANCE TRAINING

BALANCE CONTROL – SPECIFIC NEUROMUSCULAR CHANGES WITH AGE

BAUDRY, S.
UNIVERSITÉ LIBRE DE BRUXELLES

From a biomechanical perspective, upright standing in humans can be described as an inverted pendulum rotating around the ankle joint with the intended equilibrium position being a slight forward tilt of the body that generates a gravity-driven instability. As passive ankle stiffness is not sufficient to avoid forward falling, active modulation of plantar flexor muscles is needed. This requires the integration of inputs from proprioceptive, cutaneous, visual, and vestibular sensory systems, with the proprioceptive system as the main source of relevant sensory inputs to control unperturbed upright standing. Postural stabilization can therefore be considered as a sophisticated computational task which depends upon a number of central and peripheral factors. When the functioning of these contributing factors begins to decline, such as during healthy ageing, the nervous system must change the way the active ankle stiffness is controlled. The purpose of this talk is to provide a rationale for the hypothesis of an age-associated change in the respective contributions of spinal and corticospinal pathways to adjust the soleus muscle activity when standing.

BALANCE TRAINING – SPECIFIC ADAPTATIONS WITH AGE

TAUBE, W.
UNIVERSITY OF FREIBURG

Over the human life-span we undergo tremendous changes in the neuromuscular system. Balance performance is clearly dependent on the development during childhood and adolescence, and on the degenerative processes that occur during old age. It is less known that trainability and adaptability also depend on the age. Only few studies demonstrated improved postural control after balance training in young children although the same intervention has been shown to be highly efficient in young adults and elderly subjects. It was therefore speculated that the children's immature postural control system may prevent positive adaptations. However, recent observations rather point to the fact that the balance training intervention has to be specifically tailored for children in order to motivate the participants and improve balance control. Nevertheless, young children (around the age of 6) seem to learn differently postural control strategies than older children (age around 11) as was shown in a balance training study involving anticipated and non-anticipated postural disturbances. While after a child-specific balance training both groups improved their postural control, only older children could better cope with the anticipated perturbations whereas young children did not benefit from prior knowledge about the type of perturbation. Thus, feedforward control seems to mature later than reactive balance control.
When considering the ability to adapt in response to balance training in the elderly, it becomes apparent that there are also distinct differences compared to young adults. First, the time for adaptation seems to be drastically prolonged for both behavioural and neuroplastic changes. Second, the ability to transfer acquired balance skills to previously unlearned postural tasks seems to be reduced. Interestingly, it has been shown that these differences between young and old adults are not restricted to physical training but apply also to mental balance training. The talk will summarize the current knowledge about age-specific trainability of balance control and will highlight research deficits that should be addressed in order to more specifically tailor balance interventions to the needs of different age groups.

BALANCE AND BALANCE TRAINING – TASK SPECIFICITY

GRUBER, M., GIBOIN, L.S., KUEMMEL, J., KRAMER, A.
UNIVERSITY OF KONSTANZ

It is a fundamental question whether balance training leads to highly task-specific adaptations, or more general non-specific adaptations that can be transferred to other tasks. There are conflicting study results but more and more evidence accumulates in favour of very task-specific adaptations after balance training. Recent studies that were explicitly designed to reveal task-specificity show that in healthy individuals, balance training improves the performance of the trained balance tasks, but has limited, or no effect on the non-trained balance tasks. Consequently, balance outcomes should be interpreted with care and one balance outcome might not be sufficient to generalize the results. This knowledge will greatly influence balance training recommendations as well as study design and testing procedures in balance studies, and can help to direct the investigation of the underlying physiological mechanisms of balance training adaptations. From a practical point of view, there is a need to tailor the training protocol very specifically to the needs of an athlete to improve performance or of an old adult or a patient to prevent a fall.

Oral presentations

OP-PM31 Pacing in cycling and winter sports

THE PSYCHOPHYSIOLOGICAL DETERMINANTS OF PACING AND PERFORMANCE: FALLING BEHIND AND ITS PSYCHO-PHYSIOLOGICAL CONSEQUENCES

VENHORST, A., MICKLEWRIGHT, D., NOAKES, T.
UNIVERSITY OF CAPE TOWN

Introduction

It is widely accepted that psychological factors can greatly influence human endurance performance. However, little is known about the mechanisms that underpin facilitative and even more so debilitative cause-effect relationships between psychological factors and endurance performance during competition. A three-dimensional framework of centrally-regulated and goal-directed exercise behaviour was proposed emphasizing the important role of sensory-discriminatory, affective-motivational, and cognitive-evaluative processes that underpin pacing and performance. The aim of this study was to examine the delineated contributions of the perceptual sensory, affective, and cognitive processes and their dynamic responses during a head-to-head competition.
Methods
Fourteen maximal head-to-head competition time trials between well-trained performance matched cyclists (average time difference 0.92%) over a 70 km virtual profiled course were conducted. The sensory, affective, and cognitive processes were approximated by means of scales: perceived physical (p-RPE) and mental strain (TEA), valence (FS) and felt arousal (FAS), and perceived action crisis (ACRISS), respectively. The dynamic changes in these constructs and their relationships with pacing behaviour, performance, and biochemical variables were investigated. Structural equation modelling was applied to test the hypothesized temporally linked relationships that unfold in response to falling behind.
Results
Competition outcome dependent differences were observed in the affective and cognitive dimensions as well as the endocrinological distress response. The dynamic change in valence was a significant (p=0.011) mediator in performance regulation as it explained 35% of the relationship between falling behind and action crisis. The mindset-shift associated with an action crisis was a significant predictor of the psycho-neuro-endocrinological distress response (p=0.024) and this non-conducive psychophysiological milieu predicted performance decrement (p=0.023).
Discussion
We applied, tested, and confirmed the hypothesized debilitative psychophysiological processes that unfold in response to falling behind a performance matched opponent. The main findings were: a) deterioration in valence mediated the relationship between falling behind and action crisis, b) the mindset-shift associated with an action crisis predicted exacerbated blood cortisol concentrations, and c) non-adaptive blood cortisol concentrations predicted performance decrement. The findings point towards the primary and mediatory role of core affect and mindset in endurance performance regulation. The three-dimensional framework has the potential to markedly improve our ability to explain something as complex and multi-faceted as centrally-regulated and goal-directed exercise behaviour.

PRIOR EXPERIENCE INFLUENCES PACING AND PERCEPTION DURING MIDDLE-DISTANCE CYCLING TIME TRIALS

WU, S.S.X., ZADOW, E., TORBEN, P.M., FELL, J.W., ABBISS, C.R.
UNIVERSITY OF TASMANIA

Introduction
It has recently been shown that pacing differs between time- (6 min) and distance-based (4km) cycling time trials (Abbiss et al., 2016). However, it is unclear if prior experience in time- and distance-based trials affects pacing, performance and perceptual responses. The aim of this study was to examine the influence of familiarisation on pacing, performance and perception during time- and distance-based cycling trials.
Methods
Fourteen trained male cyclists (age: 34±10 y, VO2peak: 64.0±8.6 ml/kg/min) completed three time-based (6-min; TT6min) and three distance-based time trials (TT4km) cycling time trials in a randomised, counter-balanced order. Trials were self-paced and participants were asked to complete trials to the best of their ability. Only distance feedback was provided during the TT4km and time feedback during the TT6min. Participants provided pre-trial motivational ratings, and post-trial estimated performance, effort rating and ratings of perceived exertion (RPE).
Results
Exercise time was longer during the TT4km (7:01±0:24 min), compared with the TT6min. However, average power output was similar between (358±31 and 361±40 W for TT4km and TT6min, respectively) and within trial types. Higher power output was observed at commencement of all TT4km (394±73 W), compared with TT6min (362±59 W, p=0.004). Starting power output of the initial TT4km was higher than all other trials (range: 358-385 W, p<0.029). Athletes reported 7.5% (p=0.013) more commitment to attaining performance goals prior to the first TT4km than the first TT6min. Self-reported effort was 2.3% higher (p=0.035) following TT4km, but RPE was similar between trial types. Cyclists overestimated their performance by 17.0% in the TT4km and 10.6% in the TT6min.
Discussion
Familiarisation influenced pacing in only the TT4km, but did not influence mean power output produced by trained cyclists in both trial types. Cyclists commenced all TT4km trials with a higher power output than TT6min. The faster start may be associated with the greater pre-trial commitment to performance in the first TT4km and greater reported effort following TT4km, compared with TT6min. Cyclists' were unable to effectively judge the distance or time taken to complete the trials. These findings are important in understanding the regulation of exercise intensity given that pacing is believed to be affected by our ability to judge the distance or time remaining in a trial (St Clair Gibson et al., 2006).
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Contact
Sam.Wu@utas.edu.au

INCLUSION OF MAXIMAL SPRINTS WITHIN THE WARM UP DOES NOT EFFECT PACING AND PERFORMANCE DURING A 10KM CYCLE TIME TRIAL

VEEN, J., CORBETT, M., RENFREE, A.
UNIVERSITY OF WORCESTER

Introduction
To investigate the effects inclusion of all-out sprints during warm up (WU) in an attempt to induce a Postactivation Potentiation (PAP) effect on 10-kilometer cycling time trial pacing and performance.
Methods

Following familiarization, thirteen well trained male participants performed two 10-km cycle time trials on a Wattbike ergometer following prescribed warm ups that included either four 8-s maximal sprints, or a matched total work performed at a constant exercise intensity. Power output (PO), heart rate (HR), rate of perceived exertion (RPE) and surface (EMG) were measured throughout and blood lactate [La] was measures 3 minutes post exercise.
Results
There were no significant differences between conditions in total performance time, PO in any 2-km segment, RPE or post-exercise [La].
Discussion
Addition of 4 all-out sprints in the WU did not improve 10-kilometre time trial performance or alter pacing strategy displayed, meaning that either the sprints utilised failed to induce a PAP effect, or that any effect did not translate to improved performance in this task. This may have implications for the design of warm up activities prior to similar competitive efforts.
Contact
j.veen@worc.ac.uk

EFFECT OF INTENSIFIED TRAINING ON PACING IN 4000 M CYCLING TIME-TRIALS

THOMPSON, K.G.1, WALLETT, A.1,2, WOODS, A.L.1,2, VERSEY, N.2
1UNIVERSITY OF CANBERRA; 2AUSTRALIAN INSTITUTE OF SPORT

Introduction
Studies investigating pacing require participants to present in a rested state; however competitive cyclists undertaking periods of intensified training or competing in multi-stage races will often undertake time trials in a pre-fatigued state. The aim of this study was to investigate if the pacing strategies of trained cyclists change during an intensified training period.
Methods
13 participants [(mean±SD): age 34.5±7.6 yrs; height 185.1±6.6 cm; mass 80.5±7.3 kg; VO2max 4.9±0.2 L·min-1, MAP 378±28 W, cycling training history (> 10 h·wk-1, 4±1 yrs)] completed an individualised 6-wk training program. Training load was determined from training stress scores (TSS) using Training Peaks (Boulder, USA) software. Week 1 (Baseline) was completed at the participants' regular training load, as determined by monitoring 4-wks of training prior to the study. Following the Baseline week, Build, Loading1, Loading2, Recovery1 and Recovery2 weeks were completed at 120 %, 141 %, 147 %, 79 % and 73 % of the Baseline week training load (TSS =766 ± 249 AU), respectively. Laboratory sessions were performed on calibrated ergometers (CV ±2%) (WattbikePro, Wattbike, England) at the same time of day (±1 h) with each participant using the same bike and individualised bike set-up. Participants were positioned next to others with a comparable MAP in order to provide a competitive setting. Participants undertook a weekly laboratory-based 4,000 m TT (TT), following a standardised 25-min warm-up, over the training program. Overall mean power output (MPO) was measured for each TT and for 10% bins within each TT, along with heart rate (HR, Firstbeat Technologies Ltd, Jyväskylä, Finland) and post-exercise capillary (finger) blood lactate ([Bla-], Lactate Pro 2, Arkray, Japan), RPE (6-20 scale) and Affect. A RESTQ-52 Sport questionnaire was administered on 14 occasions to assess recovery and stress states.
Results
Overall TT MPO increased during recovery weeks compared to baseline (p=0.001). Greater than 6 W increases in MPO were found for 10% bins from 1200 m to 4000 m in Recovery weeks compared to Loading weeks, and this difference in PO has been shown to be >SWC and CV in repeated TTs (Stone et al. 2011). Compared to other weeks, lower values were observed in TT peak HR during Loading weeks ($p<0.001$) and TT [Bla-] ($p<0.01$) during Loading2 and Recovery1 weeks. An interaction was observed between TT MPO, and RESTQ-52 total stress score ($F(5, 118.51) = 2.4486$, $p = 0.04$) and also the TSS ($F(5, 117.77) = 3.6222$, $p = 0.004$), whereby participants who experienced greater total stress had decreased TT MPO during Loading weeks.
Conclusion
To conclude, subtle differences (>6 W) in 10% bin MPO were observed in the latter half of trials and coincided with an overreached state.
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SKATING TECHNIQUE CHANGES IN WOMEN'S WC XC-SKIING COMPETITION

OLLONEN, P.1, OHTONEN, O.1, LEPPÄVUORI, A.1, HYNYNEN, E.2. LINNAMO, V.1
1: UNIVERSITY OF JYVÄSKYLÄ (FINLAND), 2: KIHU - RESEARCH INSTITUTE FOR OLYMPIC SPORTS (JYVÄSKYLÄ, FINLAND)

Introduction
Different pacing strategies play an important role in endurance sports. Losnegard et al. (2016) observed that the best male skiers maintain their velocity better than the slower skiers while the women's strategies do not vary significantly. V1 has been reported to be the fastest skating technique in steep uphills while in gently slopes no difference in the max speeds between the techniques was found (Boulay et al., 1995). The aim of the present study was to examine in which part of the race the best female skiers differ the most and how they use the two skating techniques (V1 & V2).
Methods
The split time analysis for female athletes (N = 31) who gained world cup points was based on video filming during WC competition (Ruka Finland, 2015, 5 km) by identifying the most important terrain against the competition results. The four filming locations were selected so that anticipated technique transitions (V1 => V2 & V2 => V1) were expected to take place in the beginning and on the top of demanding uphills. The skiers' speeds and the location of technique transitions for both techniques were analyzed.
Results
The biggest correlations ($r_s = 0{,}930$; $p < 0{,}01$) to the finish times were found for easy terrain where in comparison of two groups (G1: Best 10; G2: results 11 - 30) G1 was 3 ± 38 % faster than G2 (G1: 7,54 ± 0,11 m/s, G2: 7,32 ± 0,08 m/s; $p < 0{,}01$). In uphill terrain G1 skiers were 4 ± 200 % faster than G2 skiers (G1: 3,43 ± 0,15 m/s; G2: 3,30 ± 0,05 m/s; $p < 0{,}01$). Strategies associated with observed technique transitions were faster than 'only V1' strategy in all filming locations. The position of technique transitions correlated statistically significantly with the skiing speed only in one filming location ($r = 0{,}371$, $p < 0{,}01$).
Discussion
Even though the correlation was largest to average speed in easy terrain, the largest gaps in the competition were built and the winner was resolved in uphill terrain. World's elite skiers use both V1 and V2 techniques in uphill terrain applying different strategies while the location of a technique transition seems not to be straightforward from the speed point of view and it seems to differ very much individu-

ally. This indicates that the optimal location for a technique transition depends highly on the terrain characteristics together with the athletes' individual strengths regarding the technique transitions.

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INFLUENCE OF START PERFORMANCE ON RACE RESULTS IN SKI CROSS AND SNOWBOARD CROSS

SPITZENPFEIL, P.1, OLVERMANN, M.1, FRÜHSCHÜTZ, H.1, REISINGER, S.1, ARNOLD, E.1, HUBER, A.2
1: TUM (MUNICH, GERMANY), 2: OSP BAYERN (MUNICH, GERMANY)

Introduction
Even being part of the Olympic program since 2006, the disciplines Ski Cross (SX) and Snowboard Cross (SBX) are still regarded as "new" sports in the field of competitive winter sport. Due to this, only few research is published and the knowledge is mainly based on the experience of coaches and athletes. However, the performance at start and in the following section seems to be crucial for the performance (Argüelles et al., 2011). In a project, funded by the German Government, we analyzed the start performance and the impact on race results at several races (World-Cup, Olympic Winter Games, World Championships).
Methods
During 12 events (6 SX and 6 SBX) a total of 294 heats have been video analyzed and the rankings of the athletes at 3 different measuring points (M1= right after start, M2=at first roller, M3=after first turn) have been recorded. Additionally, all crashes during these races have been recorded and correlated to the positions at start and at the crash. Frequency distributions, correlations and probabilities have been calculated.
Results
SX: Regarding the observed races, there are significant ($p<.05$) correlations to qualify for the next round (or finish 1st or 2nd) if the racer is ranked first or second on M1 ($r=.35$), M2 ($r=.46$) and M3 ($r=.62$). In 34% of the heats crashes could be observed. From those crashes, 27% have been opponent related.
SBX: Compared to SX there are quite equal significant correlations to qualify for the next round (or finish 1st, 2nd or 3rd) if the racer is ranked first, second or third on M1 ($r=.27$), on M2 ($r=.50$) and on M3 ($r=.60$). In 46% of the heats crashes could be observed. From those crashes, like in SX, 27% have been opponent related.
Discussion
The results in SX confirm the findings of Argüelles et al. (2011) that it is very important to be on position one or two at the end of the first race section to finish first or second. According to our results, comparable findings can be found for SBX with respective values. In both disciplines, there is a quite good chance to be involved in a crash with an opponent. It can be stated, that the performance at start is very crucial for succeeding in the race. Therefore relevant movement parameters for a good start have to be investigated and then trained systematically.
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Contact
peter.spitzenpfeil@tum.de

Oral presentations

OP-PM30 Athletic training in game sports

PHYSICAL CONDITIONING AND MATCH PARTICIPATION IN ELITE WOMEN'S SOCCER

ARAÚJO, M.C., HOPPE, M.W., BAUMGART, C., FREIWALD, J.
UNIVERSITY OF WUPPERTAL

Introduction
It is assumed that a certain physical conditioning status is relevant to match performance in women's soccer (Krustrup et al., 2005).. In this way, it is expected that players with better performance in fitness tests have a higher chance to play competitive matches during the season. Thus, this study aimed to compare the physical conditioning status of elite players considering the prospective match participation.
Methods
Nineteen players of the German first division were tested at the beginning of the season for linear (LS) and nonlinear sprints (NLS), countermovement jump (CMJ), ventral (V), lateral left (LL) and right (LR), dorsal (D) and total (T) core endurance as well as for running endurance, by means of an incremental test (IT) with blood lactate measurements to determine running velocity at 2 (v2) and 4 mmol/l (v4) and an interval shuttle run test (ISRT). Individual playing time (PT) was determined using the official match reports of the Women's Bundesliga and a frequency of more than 50% of the total possible was used to divide players into More Playing Time(MPT, n=9) and Less Playing Time(LPT, n=10) groups, which were compared using the Mann-Whitney U test. Statistical significance level was set at $p\leq.05$.
Results
Season comprised 22 matches and individual PT mean was 1019.6 ± 565.10min, corresponding to 51.5 ± 28.5% (range:7.6-100.0%) of the total possible. Mean of PT was 75.0 ± 20.8% for MPT and 30.4 ± 14.1% for LPT($p<.01$,ES:2.68). MPT presented significant higher LL (83.71 ± 24.99 x 53.29 ± 12.47s, $p=.01$,ES:1.66), v2 (12.71 ± .68 x 11.06 ± 1.52km/h, $p=.01$,ES:1.49) and v4 values (13.99 ± 1.38 x 12.61 ± 1.38km/h, $p=.04$,ES:1.38) than LPT. No further significant differences were observed.
Discussion
Elite female players with better endurance do play more during the season. Since aerobic capacity is related to match performance (Krustrup et al., 2005) and female players reach relative higher speed intensities in a predominant aerobic metabolism (Baumgart et al., 2014), the results for running endurance were expected. This highlights the importance of endurance performance in women's soccer. Interestingly, no significant differences were observed in ISRT. The role of core endurance for soccer performance and the activation of specific core muscles during movements patterns should be more investigated (Borghuis et al., 2011). MPT and LPT groups did not differ

especially in explosive activities. It is also reasonable to consider that elite players have already achieved a minimum status of physical conditioning to play in high level, which could justify no additional significant differences. Further research with larger samples is desirable, also to clarify the impact of match participation on physical conditioning of elite female soccer players.

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Contact
maithe_c@yahoo.com

PHYSICAL PERFORMANCE, ANTHROPOMETRIC PROFILE AND MATURITY DEPEND ON PLAYING-POSITION AND HANDEDNESS IN YOUNG ELITE HANDBALL PLAYERS

KARCHER, C.1, BUCHHEIT, M.2, DUFOUR, SP.1.

1: FACULTÉ DES SCIENCES DU SPORT, STRASBOURG, FRANCE, 2 : MYOROBIE ASSOCIATION, MONTVALEZAN, FRANCE,

Introduction
Anthropometric profile and physical performance are playing-position dependent but few studies were done with young players and none had considered handedness. Right backs and right wings are held by left handed players. This could potentially influence the characteristics of these players (only ~10% of people are left handed (Raymond et al., 2004)). Therefore, the aims of this research were to measure the differences between physical performances, body dimensions and maturity of young players in relation to their playing positions and handedness.
Methods
134 young players (13.9±0.3 years) selected from five handball leagues in France participated in this study. Standing height, sitting height and body mass were measured and we calculate peak height velocity (PHV). Players were classified according to their playing position as back (center, left or right), wing (left or right), pivot or goalkeeper. We also measured their best performances in counter-movement jump, 6 rebound jump (RJ), 10m and 30m sprints. Between (e.g., left wings vs. left backs) and within-playing position (e.g., center backs vs. left backs) standardized differences (effect size, ES) were calculated and were interpreted using Hopkins' scale (Hopkins et al., 2009).
Results
Standardized differences ranged from trivial to very large between playing position (ES=0.1 to 3.1) and trivial to moderate within playing position (ES=0.1 to 0.8) for height, body mass and PHV. For the 10m and 30m sprints, standardized differences were trivial to moderate between (ES=0.1 to 0.9) playing position and trivial to small within playing positions (ES=0.1 to 0.4). Jumping performances (CMJ, RJ) were trivial to very large (ES=0.1 to 1.6) between playing position and trivial to large (ES=0 to 1.3) within playing position. Right-handed players were slightly taller and heavier than their left-handed counterparts (ES=0.6), they were also slightly faster in the 10m and 30m (ES=0.4) and jumped slightly to largely higher (ES=0.5 to 1).
Discussion
Anthropometric and physical profiles are playing-position dependent and are influenced by handedness. It's also important to consider the within playing-position differences. One possible reason is that trainers had less choice for left handed players.

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Contact
Claude.karcher@gmail.com

ACUTE EFFECTS OF TWO DIFFERENT TYPES WARM-UP STRATEGIES ON PHYSICAL PERFORMANCE IN PROFESSIONAL JUNIOR TENNIS PLAYERS

LÓPEZ-SAMANES, A.1, HERNÁNDEZ-DAVÓ, J.L.2, CAPELO-RAMÍREZ, F.3, FERNÁNDEZ-FERNÁNDEZ, J.4, JIMÉNEZ-REYES, P.3, MORENO-PÉREZ, V.2,3

1: UCLM (TOLEDO, SPAIN), 2: UMH (ELCHE, SPAIN), 3: UCAM (MURCIA, SPAIN), 4: ULE (LEÓN, SPAIN).

Introduction
Warm-up (WU) routine is a common practice in sports performance field. Several strategies have been used in the last years for improving physical performance during the warm-up period such as dynamic warm (DWU) (Ayala et al., 2016) and post-activation potentiation (PAP) (Saez de Villarreal et al., 2007) in several intermittent sports (Zois et al., 2013). However, the scientific literature is scarce in the tennis field. The aim of our study was to compare two different types of warm-up in several neuromuscular variables associated to tennis physical performance.
Methods
Seven elite junior tennis players (16.6±1.5 years) participated during their preparatory period of their tennis season on non-consecutive days. The tennis players performed two different warm-up protocols. For each experimental session subjects started performing a 3-min running as general warm up (GWU) before and immediately after that, in a randomized order realized a DWU protocol (e.g. straight leg march exercise) or PAP (i.e. 1 set of 3 repetitions at 85% of 1RM of leg press exercise). At two time-points (after the GWU and, 5 minutes after both DWU and PAP, the subjects realized a neuromuscular test battery consisted of countermovement jump (CMJ), 505 agility test (505), Maximal Velocity 20 m (Mv20) and passive hip flexion (straight leg raise test) and extension (modified Thomas test) range-of-motion test (ROM).
Results
CMJ and 505 augmented in both protocols respectively by 7.68 ± 2.32% (93/7/0 likely positive) and 2.95 ± 0.16% (58/42/0 possibly positive) in the DWU protocol and 4.34 ± 2.82% (35/65/0 possibly positive) and 3.44 ± 0.06% (81/16/3 likely positive) in the PAP protocol no reaching statistical significance in this group. Therefore, Mv20 improve in the DWU by 2.60± 0.99% (52/48/0 possibly positive) but not in the PAP protocol -4.22 ± 0.93 (1/17/83 likely negative).
Discussion

Our data suggest that DWU could be a better strategy for improving tennis physical performance comparing PAP, however further investigation is needed to confirm our findings.

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Contact
alvarolsamanes@gmail.com

THE EFFECT OF TRAINING ON PERIPHERAL NEUROMUSCULAR FATIGUE INDUCED BY REPEATED CHANGE OF DIRECTION IN BASKETBALL.

FERIOLI, D.1,2, BOSIO, A.1, BILSBOROUGH, J.C.3,4, TORNAGHI, M.2, LA TORRE, A.1, RAMPININI, E.2
1 UNIVERSITÀ DEGLI STUDI DI MILANO, MILAN, ITALY; 2 MAPEI SPORT RESEARCH CENTER, OLGIATE OLONA, ITALY; 3 UNIVERSITY OF TECHNOLOGY SYDNEY (UTS), AUSTRALIA; 4 BOSTON CELTICS, USA

Introduction
Change of direction (COD) is considered an important physical determinant of basketball performance (McInnes, 1995). Understanding how COD can influence physical abilities may provide insights into player performance. Optimal training load (TL) prescription, during the preparation phase of the season, is required to optimize player performance. Relationships between TL and changes in player fitness have been investigated in team sports such as soccer and rugby (Jaspers, 2016) but never in basketball. This study aimed to quantify changes in peripheral neuromuscular fatigue induced by repeated CODs after the preparation period and to determine their relationships with the TL (sRPE) sustained by professional (PRO) and semi-professional (SPRO) basketball players.
Methods
Pre (T1) and Post (T2) the preparation period, peripheral neuromuscular function of the knee extensors (peak torque, PT) was measured using electrical stimulation during a repeated 180° COD test, consisting of 4 levels with increasing intensities (PT1, PT2, PT3 and PT4), in 12 PRO and 16 SPRO basketball players. Furthermore, PT_MAX (the highest value of PT) and PT_DEC (PT decrement from PT_MAX to PT4) were also calculated.
Results
At T2, from possibly to likely lower PT1 (PRO: 69.8±10.9 vs 65.0±10.1 N/m; SPRO: 61.8±14.8 vs 58.7±13.2 N/m) and PT2 (PRO: 76.2±11.8 vs 72.2±10.8 N/m; SPRO: 68.3±14.9 vs 64.4±13.9 N/m) were observed in both groups, while a very likely greater PT4 was found in PRO (56.0±19.6 vs 65.8±15.3 N/m) and SPRO (50.6±16.5 vs 58.7±13.3 N/m). No clear variation was observed in PT_MAX in PRO (76.8±12.0 vs 73.8±11.5 N/m), while a possible reduction was found in SPRO (69.1±14.6 vs 65.6±13.9 N/m). Reductions in PT_DEC were almost certain in PRO (27.8±21.3 vs 11.4±13.7%) and very likely in SPRO (26.1±21.9 vs 10.2±8.2%). Moderate relationships were found between TL and changes in PT1 (r=-0.45±0.26), PT2 (r=-0.44±0.26), PT3 (r=-0.40±0.27) and PT_MAX (r=-0.38±0.28).
Discussion
The current findings suggest that the ability to sustain repeated CODs efforts may be improved after the preparation period, as peripheral neuromuscular fatigue induced by a COD test was reduced in both groups. Small reductions in PT were observed when CODs were performed at low and medium-low intensities. The observed relationships suggest that high TL may negatively affect peripheral neuromuscular function during the preparation period.

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Contact
davide.ferioli@unimi.it

Oral presentations

OP-BN14 Performance analysis in team sports

DISCUS POSSESSION IN THE ULTIMATE FRISBEE UNDER 23 WORLD CHAMPIOSHIP FINALS

RUSSOMANNO, T., MERCADANTE, L.A., COSTA, F.R., SOUZA, L.F., OLIVEIRA, T.C.
UNB UNIVERSIDADE DE BRASILIA, UNICAMP

Introduction
Ultimate Frisbee is an exciting, non-contact team sport, that combines elements from soccer, football and basketball. The players must pass the discus to the end zone to score a goal. For some authors the interception of pass is the common way to recover the discus possession and block the adversary attack sequences. Therefore, the possession of the discus is an important element in the game. Based on this, the aim of this study is to quantify the discus possession in the ultimate Frisbee finals of the world championship under 23 years.
Methods
Two broadcasting videos from the finals and semifinals of the 2015 world championship were used to game analysis. The Dvideow software was used for manual quantification of the discus possession frame by frame. The games were the male's semifinals and final between USA x Great Britain and USA x Canada respectively. The discus possession was divided in hand possession, flying possession and no possession defined. It was also measured the number of right and wrong passes for each team. The quantification was performed by specific setup of the software interface for Ultimate Frisbee.
Results
The results show that in the semifinal (USA 14 x10) 30% of the time the discus was in possession of the teams and the other 70% of the time the possession in undetermined. In the final game (USA 17 x 11), it was observed that 24 % of the time there is teams' possession of the discus and 76% of the time the possession was indeterminate. In the semifinal, it was identified 191 right and 35 wrong passes for

USA and 148 right and 38 wrong passes for GB. In the final game, USA had 156 right and 10 wrong passes against 137 right and 15 wrong for CAN. The results also showed that the team with a higher number of pass won the game.
Discussion
It can be noticed that in both games the indeterminate possession was approximately 70%, indicating that in great part of the game the players were not in movement and the discus was immovable. So, it can be suggested that the match has fast and short plays, supporting the findings of Di Michele and Ometto[2], who in their research revealed that physical effort in Ultimate is characterized by several short and repeated sprints, combined by long recovery times. It is good to emphasize that constant indeterminate discus possession in the results involves the absences, turnovers, goals, pulls and timeouts, which justify the high percentage of indefinite possession demonstrated in the study. Possession shows that in the first and second games the American team had the smallest possession of the discus in hand compared to the other two teams. This is because USA exchanged more short and fast passes. Showing that they hold the discus for a short time and try to open space in the opponent's defense. So, they are more objective and try to reach the opposing end zone faster. The major contribution of this study was to develop an analysis method of discus possession in the Ultimate Frisbee.
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Contact
tiagorussomanno@unb.br

ANALYSIS OF SETTERS PASSING BEHAVIOR WITHIN COMPLEX 1 IN VOLLEYBALL BY MEANS OF ARTIFICIAL NEURAL NETWORKS

SCHRAPF, N.1, HASSAN, A.1,2, TILP, M.1
INSTITUTE OF SPORTS SCIENCE

Introduction
Analysis of players' behavior in sport games is essential for successful training adjustments and the preparation for competition. Since teams demonstrate specific variability in their behavior (Jäger & Schöllhorn, 2012), it can be assumed that individual behavior of players allows discriminating them by individual movement parameters. Therefore, the aim of the present study is to identify setters in volleyball based on movement parameters during the first setting following the service and to predict the type of passing.
Methods
For the analysis, 149 rallies from 3 setters of the 2nd Austrian Volleyball League Women were considered. The position of the setter at the instant of the serve, the position of the reception, the time elapsed between the reception and the setters pass, the position of the pass and the type of the passing action were recorded with custom-made game analysis software. The passing type was defined by the target position and the passing speed. Subsequently, data was analyzed by means of artificial neural network (ANN) software NeuroDimension. The ANN to identify the acting setter was trained (supervised learning) with 70% of the datasets. The rest was used for cross validation (15%) and to identify the setter (15%). A separate network was then used for each setter to predict the type of pass. The accordance of the predicted and the real values was assessed by the percentage of correct predictions. Binominal distribution was used to check if the assignment is significantly better than by chance.
Results
The ANN identified the setters correctly in 59.1%. Depending on the setter, passing type was correctly predicted in 57.6% (±16.1) for the target position and in 83.3% (±12.5) for the passing speed.
Mean identification rate was significantly higher than by chance (p=0.01) and individual playing style of one setter could even be identified with high accordance (87.5%). Furthermore, passing type, specifically the passing speed, could be predicted to a great proportion.
Discussion
Such information might be very helpful for trainers in the preparation for competitions to anticipate playing actions of opponents. A shortcoming of this pilot study is the small amount of data and conclusions are restricted to the investigated playing level. We expect better results with more data because ANNs improve their learning ability with larger datasets. However, discrimination of high professional volleyball players is possibly more difficult due to less individual behavior.
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DEFENDING IN FOOTBALL: THE KEY TO ANTICIPATE SUCCESSFULLY

VICENTE, A., FERNANDO, C., LOPES, H.
UNIVERSITY OF BEIRA INTERIOR, UNIVERSITY OF MADEIRA, CIDESD

Introduction
Over the past few years we have been witnessing a greater concern in football with the defensive organization of teams. Football teams seem to seek to organize defensively to give as few chances as possible to their opponents.
Although the defensive organization relies heavily on coordination with teammates, reading their opponents and anticipating their possibilities for action also seem to be decisive for the success of a good defensive organization. This agrees with studies that we have been developing based on isolated situations (e.g. Vicente et al. 2013) that showed there are time relations with the opponents that players must not ignore to succeed.
In this sense, and in the continuation of the studies that we have been developing, the objective of the present work was to verify whether a correlation exists between the velocity of the stimulus of an attacking footballer and the defending footballer's responses.
Methods
We've used a software (MeSiR3.1) designed to measure the relation between the velocity of the stimulus and the time to respond it. Two tests were used. Each test corresponded to a situation previously filmed in order to be projected in real size to the participants:
Test 1 had a football attacker who ran with a ball (at two different speeds ±10km/h and ±20km/h) in the direction of the alleged defender and shifted the direction of his movement to the left or right at about 2 meters from the defender's position;
Test 2 had the same football attacker who ran without ball (at two different speeds ±10km/h and ±20km/h) in the direction of the alleged defender and shifted the direction of his movement to the left or right at about 2 meters from the defender's position;
42 university football players and 21 semi-professional footballers had to perform each test for 20 trials and respond to each situation by moving their body towards the same side that the attacker moved in each test.

Results
From the 2520 trials performed from both tests, results showed that players took the right decision in 79% of the situations.
Data also showed that for the fastest stimulus the average response time was also higher (test 1=386s / test 2=354ms) than the slowest stimulus situations (test 1=414ms / test 2=392ms). Players were faster in anticipating the attacking displacement when they were running with the ball than without it.
Discussion
Data showed that the stimulus velocity tend to influenced the response and the time to respond. As the stimulus was faster or slower the response was also faster or slower. The results corroborated previous studies (e.g. Vicente et al. 2015) and other ecological studies that we are still performing. This suggest that in football defenders must be prepared to anticipate the attackers actions being aware that they can influence their actions and response times to take advantage and increase success chances.
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DEFENSIVE BALANCE IN ELITE FOOTBALL: APPLICATION OF EXPERT OBSERVATIONS

SCHULZE, E., MEYER, T.
SAARLAND UNIVERSITY

Introduction
Attacking efficacy in elite football (soccer) has previously been linked to defensive balance (Tenga et al., 2010). This concept relates to the balance among defensive players and that between the defending and attacking team. It has been shown that inter-team balance is perturbed prior to goal-scoring opportunities (Moura et al., 2016). The present study aimed to measure defensive balance before shooting situations through expert observations and determine its applicability.
Methods
Six performance analysts and coaches (2-15 years of experience with match analysis) completed one familiarisation and two experimental trials. During each experiment nine clips (duration: 8-19s) involving goal-scoring opportunities in matches between different elite international teams were shown in randomised order. The balance observed within the defensive organisation was rated in 1s-intervals on a 5-point scale. For every four consecutive ratings, the slope over the log-transformed scores was calculated to determine when defensive balance was disturbed most. Participants also had to indicate which second they deemed decisive during each attacking sequence. Quadratic weighted Cohen's Kappa's were calculated to determine agreement.
Results
For the ratings per second, steepest slope, and decisive second moderate between-participant agreements were found for Experiment 1 (K=0.41-0.52) and 2 (K=0.42-0.46), respectively. The within-participant agreement for these measures was good (K=0.67-0.73). No significant learning effect between the experiments was found (P=0.49). The agreement between the steepest slope and decisive second was moderate (K=0.49-0.59). For 7 out of 9 clips, forward passing was deemed decisive for creating the goal scoring opportunity.
Discussion
The results of the present study show that experts are able to reliably describe the development (through ratings per second) and loss (through selection of one instance within a sequence) of defensive balance within attacking sequences, although between-observer differences exist. However, since good to very good agreements were found within observers, practitioners could study the playing actions preceding the moment at which defensive balance was disturbed most for their team or opponent. This may lead to useful information regarding team playing style and player qualities. Taken together, defensive balance seems to be a promising concept which can be applied by experts in order to further study playing efficacy.
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Contact
emiel.schulze@uni-saarland.de

PACKING IN FOOTBALL: A DIFFERENTIAL ECOLOGICAL PERSPECTIVE ON PASSES

STEINER, S.1, RAUH, S.1, RUMO, M.2, EMERY, N.2, SONDEREGGER, K.2, SEILER, R.1
1: ISPW, UNIVERSITY OF BERN (BERN, SWITZERLAND), 2: SFISM (MAGGLINGEN, SWITZERLAND)

Introduction
Packing has had its major appearance at the UEFA European Championship 2016. It indicates how many opponents are packed ("taken out" of the game) by a pass (http://www.impect.com/de) and has established as an inherent part of game statistics. In general, passes are more probably played to team members with open passing lanes, standing relatively close to the ball carrier, positioned in front of the ball, and defended loosely by opponent players (unpublished data). The goal of this study was to test whether passes with different packing differ in their relationships to ecological features of the game context.
Methods
Game data from five football competitions between some of Switzerland's best-ranked U-18 teams were collected by the Local Positioning Measurement System of the Swiss Federal Institute of Sport. The system records the positions of opponent teams with little time latency and a high data resolution. Time synchronized videos were used to identify passing situations. 1778 completed passes were identified and categorized according to their packing. For each pass, the positions of all 22 players were exported to calculate the team members' distance to the ball carrier, the openness of the passing lane, the defensive coverage, and the position before or behind the ball. Logistic regressions for binomial data were specified to estimate the effect of the ecological variables on passes with different packing.
Results
In contrast to the significant effects found when considering all passes, the openness of passing lanes was no ecological information that significantly affected passes with a packing of greater-than-or-equal to two. In a similar way, no effect of defensive coverage was found for passes with a packing of greater-than-or-equal to three.
Discussion
Passes with a packing of three and more do not show the characteristic effects of open passing lanes or loose defence of the intended receivers. They could, compared to passes with a lower packing, be considered risky passes. The findings may cautiously be interpreted

in regard to the athletes' specific use of ecological information. It might be argued that athletes playing passes with high packing oppress ecological information that are usually more heavily weighted in passing decisions. Or, they more heavily weigh or rely on other information to guide their passing behaviour. More research is required to prove the adequacy of this interpretation.

AN APPROACH TO ANALYZE THE RELATIONSHIPS BETWEEN BASKETBALL REFEREES AND TEAM PERFORMANCE

WANG, S., HSIEH, W.

FO GUANG UNIVERSITY, NATIONAL TSING HUA UNIVERSITY

Introduction
In a basketball game, referees play an important role for the performances of both teams.
For the same body contact situation, different referees may have different judgment and the judgment may affect the result of the game.
Note that this study is based on the assumption that the referees are all fair and the effects result from different judicial discretion of each play of the game.
In order to minimize the referee's effect to a game, the selected referees of a game should not affect the team performances significantly no matter the referee is good or bad for the team.
This study aims to propose an approach to figure out the relationships between a referee and a team based on the history data using statistics techniques.
Methods
The proposed approach is as follows:
1) For each team, the records in which the team involved are analyzed. Mean value and standard deviation of all its own scores are calculated. 2) In these records, for each referee we also calculate the mean and standard deviation of the values when a referee is responsible for this game. 3) Then, we use statistical hypothesis testing(T-test) to test if the two set of data are significantly different.
If no, it means the referee does not affect the team's performance and he is suitable for the game in which the team is involved.
Otherwise, the referee may let the team be in advantage or disadvantage to its opponents and we said the referee is unsuitable for the team.
Results
We analyze 525 Super Basketball League games in which 7 teams and 56 referees are involved.
The confidence interval are 90% in our test. We construct a table in which each cell is the testing result between a referee and a team.
Among the 56 referees, the maximum and average numbers of teams for which the referee is unsuitable to officiate are 3 and 0.71 respectively. For all teams, the maximum and average numbers of unsuitable referees are 8 and 5.71 respectively from 56 referees.
Discussion
The results of this study is able to improve the quality of basketball games in the future.
If a referee is unsuitable for many teams, the referee must improve his quality of officiating.
For the referees assignment, the referees assigned to a game should be selected from the referees who is suitable for both teams.
This study can be extended to analyze other different values in a game such as opponent scores, fouls, or their combination.

Oral presentations

OP-BN20 Cortical and corticospinal excitability

THE EFFECT OF ACUTE LOW-INTENSITY AEROBIC EXERCISE ON INHIBITORY AND EXCITATORY CIRCUITS IN THE PRIMARY MOTOR CORTEX

YAMAZAKI, Y., SATO, D., YAMASHIRO, K., UETAKE, Y., NAKANO, S., MARUYAMA, A.

NIIGATA UNIVERSITY OF HEALTH AND WELFARE

Introduction
Previous studies have suggested that acute aerobic exercise modulates intracortical neural circuits in the primary motor cortex (M1). However, the effect of low-intensity aerobic exercise on M1 circuits remains unclear. In the present study, we investigated the changes to inhibitory and excitatory circuits in M1 induced by acute low-intensity aerobic exercise using transcranial magnetic stimulation (TMS) on human subjects.
Methods
Twelve healthy right-handed subjects participated in two experiments: Experiment 1) evaluation of the inhibitory circuit in M1 during an exercise and control session. Experiment 2) evaluation of the excitatory circuit in M1 during exercise or control. In the exercise session, subjects performed low-intensity cycling at 30% VO2 peak for 30 min. EMG activity was recorded from the right first dorsal interosseous (FDI) muscle. TMS pulses were applied over the hand area (FDI hot spot) of the left M1. TMS measurements were performed before and after exercise at multiple time intervals (immediately, 20 min, 40 min, and 60 min). In experiment 1, short-interval intracortical inhibition (SICI), long-interval intracortical inhibition (LICI), and short-latency afferent inhibition (SAI) were measured to assess the function of the inhibitory circuit in M1. In experiment 2, intracortical facilitation (ICF) and short-interval intracortical facilitation (SICF) were measured to assess the function of the excitatory circuit in M1.
Results
In experiment 1, SICI and LICI did not change, whereas SAI significantly decreased 20 min after exercise ($p < 0.01$). In experiment 2, ICF was significantly lower in the exercise session than the control session for the immediate ($p < 0.05$), 20 min ($p < 0.01$), and 40 min ($p < 0.05$) time points after exercise. However, SICF did not change.
Discussion
One possible explanation for the observed modulation of inhibitory and excitatory circuits by acute low-intensity aerobic exercise is the effect of neurotrophic factors and neurochemicals such as brain-derived neurotrophic factor and serotonin. Levels of these factors are increased by aerobic exercise and have been shown to modulate neural circuits. Thirty minutes of low intensity aerobic exercise modulates inhibitory and excitatory circuits in M1.
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PROLONGED MOTOR IMAGERY INCREASES MOTOR-RELATED CORTICAL POTENTIAL AMPLITUDE AND PERCEPTION OF EFFORT DURING IMAGINED AND ACTUAL ISOMETRIC KNEE EXTENSIONS

PAGEAUX, B.1, JACQUET, T.2, BARD, P.2, PFISTER, P.2, POULIN-CHARRONNAT, B.2, LEPERS, R.1

UNIV. BOURGOGNE FRANCHE-COMTÉ, FR

Introduction
Motor imagery (MI) is the mental simulation of action without concomitant movements. When prolonged, MI increases feelings of fatigue and impairs motor control without altering force production capacity. In the present study, we tested the impact of prolonged MI on the motor-related cortical potentials amplitude (MRCP, index of premotor and motor area activity) and perception of effort (PE) during imagined and subsequent actual isometric knee extensions. As an increase in feelings of fatigue increases PE, we hypothesised that prolonged MI would increase PE during a prolonged MI session, and during a subsequent physical task. Furthermore, changes in PE being associated with changes in MRCP, we hypothesised that the increase in PE would be associated with an increase in MRCP amplitude.
Methods
Fourteen subjects completed a MI session and a control session. In the MI session, subjects imagined 200 maximal isometric knee extensions (5 s ON – 10 s OFF, duration 50 min). In the control session, subjects watched a documentary for the same duration. Each cognitive task was followed by 150 voluntary isometric knee extensions (2.5 s ON – 5.5 s OFF) at 50% pre cognitive task maximal force. During MI, PE and MI vividness were measured every 50 imagined contractions. During the physical task, PE was measured every 15 contractions. EEG signal was recorded during the whole session to obtain MRCP for each imagined and actual isometric knee extension.
Results
During MI, PE ($P<0.001$) increased overtime and MI vividness decreased overtime ($P=0.018$). During the physical task, contraction rate of force development and knee extensors EMG did not differ (all $P>0.928$) between conditions (MI vs control). A significant interaction effect ($P=0.011$) revealed that the increase in PE during the physical task was greater following MI compared to watching a documentary. Preliminary EEG analysis ($N=12$) on MRCP amplitude revealed that i) MRCP during imagined contraction increased overtime ($P=0.013$), and ii) MRCP during actual contractions increased to a greater extent following MI compared to watching a documentary ($P=0.023$).
Discussion
Prolonged MI increases PE and MRCP amplitude during imagined and subsequent actual isometric knee extensions. The concomitant changes in MRCP and PE provide evidence that PE is related to premotor and motor area activity, and support the corollary discharge model of PE. Further investigations are required to identify the underlying mechanisms responsible of the increased premotor and motor areas activity induced by prolonged MI.
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EFFECT OF STIMULATION FREQUENCY ON CORTICOSPINAL EXCITABILITY

VITRY, F., DELEY, G., MARTIN, A., PAPAIORDANIDOU, M.

INSERM U1093 - UNIVERSITÉ DE BOURGOGNE FRANCHE-COMTÉ

Introduction
Studies having examined the effects of peripheral nerve stimulation on corticospinal excitability of the lower limbs have reported an increase (Khaslavskaia et al, 2002) or a decrease (Leonard et al, 2013) in corticospinal excitability. These discrepancies can be explained by the differences in the stimulation parameters. The aim of this study was to assess the effects of stimulation frequency on corticospinal excitability of the soleus muscle (SOL).
Methods
Twelve healthy subjects participated in one experimental session consisting of electrical stimulation applied over the tibial nerve at the popliteal fossa. Stimulation trains (20s duration, 1ms pulse width) were delivered at two stimulation frequencies (20Hz and 100Hz) and at 7 intensities (90%, 100%, 110%, 120%, 130%, 140% at 150% of the motor threshold). Before and after the stimulation trains, corticospinal excitability was assessed at rest by trancranial magnetic stimulation, eliciting motor-evoked potentials (MEP) of SOL muscle. Spinal excitability at rest was assessed by the H reflex. Finally, a twitch at each stimulation intensity was delivered before (pre) and after (post) each stimulation train. Since, M wave was not affected at post measurements, all electrophysiological parameters (MEP, H reflex and EMG associated to the twitch at each stimulation intensity, ie. Htwitch and Mtwitch) are presented as a function of pre values.
Results
Statistical analysis revealed a significant effect of stimulation frequency on corticospinal excitability ($p<0.01$), with the 100Hz stimulation inducing a higher increase at post conditions. Spinal excitability was not affected at post conditions by either intervention, while Htwitch was significantly increased ($p<0.05$) and Mtwitch was significantly decreased ($p<0.01$) at post conditions only for the 100Hz.
Discussion
These results indicate that the application of high frequency and short-term stimulation can induce increases in corticospinal excitability. This can be explained by the greater Ia afferent solicitation during the 100Hz trains, as indicated by the Htwitch potentiation at post measurements.
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CORTICOSPINAL CHANGES INDUCED BY CONCENTRIC VERSUS ECCENTRIC SINGLE-JOINT EXERCISES

GARNIER, Y.

INSERM U1093 CAPS - UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ

Introduction

Corticospinal (CS) excitability is specifically modulated according to the mode of muscle contraction (1). Compared to rest, CS excitability increases during concentric contractions (CON) while it decreases during eccentric contractions (ECC) (2). Exercise-induced fatigue also modulates CS excitability but it may differ between CON and ECC contractions (3). The aim of this study was to investigate the effect of the mode of muscle contraction on CS excitability changes during and after fatiguing sub-maximal exercise of the knee extensors muscles.
Methods
Twelve healthy volunteers participated to this study (age: 28 ± 8 years) involving 2 experimental sessions. Both sessions included 10 sets of 10 isokinetic contractions of the knee extensors performed either in CON or in ECC conditions. The same target torque (80% of maximal isometric voluntary contraction (MVIC)) was used in both conditions to ensure a similar total workload at the end of exercise. Motor evoked potential (MEP) amplitude and cortical silent period changes were assessed on vastus medialis (VM) and rectus femoris (RF) muscles using transcranial magnetic stimulation during and immediately after exercise. M-wave and mechanical responses of electrically evoked, single and paired, pulse stimulation were also assessed to investigate changes in excitation contraction coupling process and voluntary activation level (VAL).
Results
Reductions in MVIC torque (-13%), VAL (-12%) and peak twitch (-12%) was similar after both CON and ECC exercises. Compared to baseline, normalized MEP amplitude of VM and RF muscles was significantly depressed during eccentric exercise by 60% and 36%, respectively. However, MEP amplitude of both VM and RF muscles remained stable from the beginning until the end of both exercises. After CON exercise, cortical silent period increased significantly (+57%) for RF muscle, while after ECC exercise MEP amplitude of RF muscle was reduced by 24%. No significant change in MEP was observed for VM muscle after both exercises.
Discussion
When the total muscle workload was matched, muscle fatigue was similar after prolonged submaximal CON or ECC contractions of the knee extensors. This study showed that the mode of muscle contraction did not modulate CS changes during prolonged submaximal exercise. In contrast, few modulations of CS excitability were observed for the RF muscle after exercises suggesting the occurrence of intracortical inhibition changes in the bi-articular muscle. Future studies should examine how the mode of muscle contraction could modulate cortico-cortical networks during fatiguing exercise.
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MOTOR CORTICAL REPRESENTATION IN TWO DIFFERENT STRENGTH-TRAINING MODALITIES REVEALED BY TRANSCRANIAL MAGNETIC STIMULATION

JØRGENSEN, R., OSUNA-FLORENTZ, P., STEVENSON, A., MRACHACZ-KERSTING, N.
AALBORG UNIVERSITY

Introduction
One of the sites that can be affected by motor training is the primary motor cortex (1,2,3), but sometimes learning a movement is only the beginning of a training regime. The effect of resistance training on corticospinal function is still unclear, and previous studies have often focused on minor distal muscles (4,5,6). Therefore, the aim of this study was to investigate which of two commonly used resistance-training regimes, explosive and non-explosive, yielded the largest cortical representations in vastus lateralis (VL) and biceps femoris (BF).
Methods
Eighteen participants were recruited and divided into two groups based on their training experience (explosive and non-explosive resistance trained). The participants had a minimum of two years of experience with either weightlifting (snatch and clean and jerk) or conventional resistance training.
Transcranial magnetic stimulation was used for mapping motor cortical representations (MAP) of VL and BF in an active state (~5-10% of a squat). The stimulation intensity used was slightly above active motor threshold (~105%).
Results
The MAP area for VL was significantly larger for the explosively trained than for the resistance trained (8448 ± 6121 μV and 3350 ± 1920 μV, respectively, p= 0.04). There was no difference in MAP area for BF.
Discussion
The larger cortical map area for VL in the explosively trained group may be due to the training of their leg muscles being more structured and frequent (i.e., number of times the leg muscles are trained per week) than the training of the conventional resistance training group. It has previously been shown that it is the continuous learning of a skill, which facilitates an expansion of cortical representation, rather than simply muscle strength (7). Weightlifting is more complex and variable because of the explosive change in direction compared to conventional resistance training, thus the continuous learning phase may be longer for weightlifters.
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Invited symposia

IS-SH04 Prevention of Sexual Harassment and Abuse in Sports

PREVENTING SEXUAL HARASSMENT IN ZAMBIAN SPORT – THE VOICES OF ATHLETES AND COACHES

FASTING, K., HUFFMAN, D. SAND, T.S.
NORWEGIAN SCHOOL OF SPORT SCIENCES

The Norwegian Olympic and Paralympic Committee and Confederation of Sports (NIF) has, for many years, carried out a gender program in the southern African region. The program has involved building understanding of gender and developing an awareness and actions related to reducing gender-based violence (GBV) in sports.
Over the last 20 years, the results from studies on SH have been utilized in making policies, educational and preventive programs in many countries. Though these studies have presented the athletes experiences, they seldom have asked them about their opinion with respect to preventive measures. The study presented took place in Zambia and was carried out in cooperation with the National Olympic Committee of Zambia and NIF. In this presentation, prevalence data on SH among the athletes will be presented together with suggestions from athletes and coaches about how sexual harassing behaviors can be prevented.
The participants were female and male athletes and coaches, born in 2000 or earlier. Eight different sports were represented. The total sample consisted of 410 athletes and 116 coaches. The participants took part in a workshop that lasted for about 3 hours and consisted of: filling out a questionnaire related to gender-based violence then an interactive lecture focusing on empowerment, human rights and ethical behavior in sport. Verbal, non-verbal and physical sexual harassment were measured with 7 items. On an open question the athletes and the coaches were asked to formulate two initiatives that they thought "should be taken to prevent athletes from experiencing harassment and gender based violence in sports". In addition, 11 initiatives to prevent harassment and abuse from occurring were listed. Participants were asked to mark up to three possible solutions that they believed would be effective.
The prevalence of verbal, non-verbal and physical sexual harassment was 59%, 52% and 50% respectively. No significant gender differences were revealed for the SH measurements. On the open-ended question initiatives related to "training, education, workshops, information" were mentioned considerably more than other initiatives. "System for punishment of perpetrators" and "respect for each other" were the second and third largest categories. Among the 11 initiatives listed in the questionnaire "Adopt a policy against harassment and gender-based violence", "Education/training of coaches about harassment and gender-based violence" and "Education/training of athletes about harassment and gender-based violence" were marked most often.
It was surprising that no gender differences were found for the experiences of sexual harassment. This is discussed in relation to results from other studies and with respect to gender theories. The proposed actions for prevention measurements will be discussed in relation to policies that have been developed in other countries and by other organizations i.e. the IOC. Finally recommendations for decision-makers in Zambian sport are presented based on the results of the study.

CHILD SEXUAL ABUSE IN SPORT AND LEISURE SETTINGS: REPORTS TO ENGLISH LOCAL AUTHORITIES 2010-15

HARTILL, M.
EDGE HILL UNIVERSITY

Under-reporting of sexual violence is a significant and persistent problem. National data on the reporting of sexual violence in sport is difficult to come by, however, official records can assist in building more detailed pictures of case dynamics and reporting patterns within a particular setting(s) and national context. In the UK, local authorities are a key element of the child protection/safeguarding infrastructure and are often the first point of contact for public and voluntary sector organisations when a report or allegation of child abuse is made. All local authorities in England are required to document any reports of child maltreatment they receive. Therefore, their records include data relating to child sexual exploitation and abuse in sport/leisure contexts. However, this data is not disaggregated and retrieving sport-specific data is difficult. This paper presents findings from a Freedom of Information Request designed to isolate data on reports of abuse in sport and leisure settings from local authority records for the period 2010-2015. A response rate of 46% generated data from 70 local authorities, providing details on 1033 separate cases of child maltreatment in sport. Of these reports, 41% (n=421) relate to child sexual abuse (CSA) (17% physical; 3% emotional; 2% neglect; 7% other; 30% unknown). This paper explores the data in relation to reports of CSA through a number of variables including sport-type, year, reporter, gender and outcome. Implications for prevention, education and research are considered.

Oral presentations

OP-SH14 Social factors and sport

INVESTIGATING THE MANAGEMENT OF THE ELITE SPORT SUCCESS FACTOR TRAINING FACILITIES

BÖHLKE, N., BÄHR, H.
OSP BERLIN

Introduction
The blueprint for elite sport systems is known for over a decade (Green and Oakley 2001). Today, researchers and practitioner appear to share a common understanding of the building blocks that constitute such systems. More recent research started to focus in more detail on the different elements of this blueprint - what the different building blocks entail, how the different elements are managed, etc.. This article follows this trend by focusing on the elite sport success factor training facilities. We investigated if managers from different training centres in different countries deliver the same service portfolio and deal with similar tasks in their daily work.
Methods
We developed an online survey based on Böhlke and Neuenschwander's (2015) list of items describing a training environment and circulated it among senior staff members of elite sport training centres around the world.
Results

In total we collated 24 data sets from 15 countries. The respondents showed striking similarities in some aspects and significant differences in others. The most profound difference was the finding that the task spectrum managers are confronted with seems to vary a lot between centres – even between centres from the same sport system. Also, all respondents appear to deal a lot with different stakeholders to ensure that all necessary services are provided at their centres - this even though the centres in our survey were predominately 'state-funded'.
Discussion
Firstly, our work highlights to practitioners, politicians and researchers dealing with aspects of elite sport systems and their management to expect a lot of variety on the operational management level in these structures. This even if a task appears to be as generic as running an elite sport appropriate training centre. Secondly, our results show that stakeholder management appears to be an important skill for managers of elite sport training centres. This might constitute an interesting field for (further) education initiatives for centre managers.
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THE COMPARISON OF SPORT SYSTEM AND SUPPORT FROM SOCIAL ENVIRONMENT BETWEEN CHINA AND EUROPEAN COUNTRIES IN ATHLETIC TRANSITION AND CAREER DEVELOPMENT

CHENG, W., KUHN, P.
BAYREUTH UNIVERSITY

Introduction
The retirement and resettlement of athletes has still been one of the most serious social problems in China. Scholars in Europe have devoted themselves in the domain of impact that the social environment exerts on the transition and career development. The different sport systems and social environments (Germany, Sweden and France) are selected and compared with China in order to find the advantages and provide the suggestions for solving the problem mentioned above and make a solid foundation for the cross-cultural comparison between German and Chinese martial arts athletes in their career transition and development.
Theoretical background. a.Transition model; b.Context paradigm c.Life-long span intervention
Methods
The literature material law.
Results
1. In Germany, a great number of clubs could offer retired athletes job opportunities; 2. In France, social organizations make close contact with sport systems providing part-time jobs; 3.The Swedish sport bodies play a role of "House keeper" through the whole career of athletes; 4. In China, during the sport career, the state controls and finances the athletes. When they retire, they survive by themselves.
Discussion
Chinese sport systems should establish strong contact between social bodies and athletes. During the career, the athletes should serve with society; during the career termination, the sport systems should take the responsibility helping them into university or society; the clubs and other social bodies should decrease the academic requirements and value their athletic ability.
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PARENT–ADOLESCENT INTERPERSONAL RELATIONSHIPS IN YOUTH SPORT: A MIXED METHODS STUDY

LISINSKIENE, A.
LITHUANIAN UNIVERSITY OF EDUCATIONAL SCIENCES

Introduction
Empirical research indicates that parents have the biggest impact on adolescents sport participation (Holt & Knight, 2014). However, greater attention is still focused on relatively specific aspects of parental behaviour in children's sporting activities (e.g., parents' role during the competition or after the competition). There is a lack of research covering a broader aspect of children's relationships with parents which could reveal the general aspect of the parent–adolescent participation in sports. The purpose of this explanatory sequential mixed methods study was to examine adolescent attachment to parents and to explore the interaction of children and parents in the context of sport in more depth.
Methods
Mixed methods explanatory sequential design (Creswell, 2015) was used in this study. In the quantitative phase the sample included 1348 adolescents, aged 12-16 (716 girls and 632 boys, M age = 14.20 years, SD = 1.52). 39.2% of the research participants (n = 529) were involved in sports for at least two years. Adolescent attachment to their parents was measured by modified Inventory of Parent and Peer Attachment–Revised (Gullone & Robinson, 2005). Hierarchical regression analysis was applied to examine the effects of participation in sport and attachment to parents. In the qualitative phase in depth interviews were conducted with eight adolescent athletes, and the resulting transcripts were analyzed using Interpretative Phenomenological Analysis.
Results
In the first, quantitative phase three attachment factors were found to be predictors of adolescents' attachment to parents: Trust ($F = 20.48$, $p < .001$, $R^2 = .07$); Communication ($F = 28.73$, $p < .001$, $R^2 = .08$); Alienation ($F = 8.78$, $p < .01$, $R^2 = .02$). In the qualitative follow-up phenomenology study three major themes emerged: 1) Adolescents' attachment to sport; 2) Parental involvement from adolescent point of view; 3) Adolescents' thoughts about parents.
Discussion
The quantitative study revealed that adolescent athletes attachment to parents is more intensely expressed in all scales: trust, communication and alienation, compared to adolescents who do not play sports and do not exercise. The qualitative study revealed that parent–adolescent interaction in sport depends on the coaching strategy selected by the coach and the degree and form of parental involvement

in children's sport. Overall the findings indicated that participation in sports has a positive effect on adolescent development and can lead to a positive family and social changes.
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Contact
lisinskiene@gmail.com

A HOLISTIC PERSPECTIVE ON INCENTIVES AND DETERRENTS FOR DRUG-TAKING BEHAVIOUR IN ELITE ATHLETES

KEGELAERS, J., WYLLEMAN, P., VAN ROSSEM, N., DE BRANDT, K., ROSIER, N.
VRIJE UNIVERSITEIT BRUSSEL

Introduction
As evidenced by regular well-published incidents, doping remains very much an issue in elite sports. It seems anti-doping work has to invest in more education and prevention to complement current repressive anti-doping strategies. In order to optimize such preventive anti-doping policies, a clear need exists to develop a better understanding of the different factors that lead some athletes to chose to use doping and others to stay clean. In order to capture the dynamic and complex nature of the decision process to use doping, the Push Pull Anti-push Anti-pull framework and the Holistic Athletic Career model were used as theoretical frameworks.
Methods
Multiple qualitative methods (i.e., face-to-face interviews, focus group interviews, biographical analyses) were used to explore the perspectives of 36 (former) elite athletes, five elite coaches, four doping 'experts', and three former doping users. All participants belonged to the Dutch speaking Belgian population. Data were analysed using deductive content analysis.
Results
A wide range of both incentives and deterrents for doping use were identified on five different developmental levels (i.e., athletic, psychological, psychosocial, financial, policy level). Push factors included: performance limitations, injuries, physical limitations, perceived pressure, risk-taking behaviour, low self-image, negative life events, supplement use, direct influencers, indirect influencers, media pressure, cultural influences, financial pressures, and perceived ineffective policies. Pull factors included: performance improvement, improving physical attributes, injury recovery, body image improvement, mental benefits, improving happiness, improving social status, and financial gains. Anti-push factors included: morality, critical thinking, support from significant others, high quality staff, team anti-doping culture, public image, cost of doping, and anti-doping policies. Anti-pull factors included: detrimental health effects, sanctions, mental struggles, reactions of important others, public humiliation, and financial repercussions.
Discussion
This study offers an in-depth insight in the complex decision process that is doping-use. Furthermore, applying the Push Pull Anti-push Anti-pull framework offers some key insights for the development of comprehensive preventive anti-doping strategies. For example, anti-doping work can be aimed at removing or minimising the impact of certain push factors and reinforcing anti-push factors. Furthermore, athletes can be educated in order to debunk certain pull factors and to highlight anti-pull factors.

Oral presentations

OP-PM69 Methods in exercise physiology 3

VALIDITY OF THE 16-METRE PACER AND SIX-MINUTE WALK TEST IN ADULTS WITH DOWN SYNDROME

BOER, P.
NORTH WEST UNIVERSITY

Introduction
The purpose was to establish criterion-related validity of the 16-metre PACER and 6 minute walk distance (6MWD) to VO2 peak, as well as predictors of VO2 peak in adults with Down syndrome (DS).
Methods
Adults with DS (24 male and 19 female) aged 18 to 50 years performed the three aerobic tests on non-consecutive days during a one-week period. To assess validity, peak oxygen uptake was measured directly on a motorised treadmill. Pearson-product moment correlations were performed. Predictors of VO2 peak were assessed with a stepwise multiple regression analysis. Agreement between PACER and VO2 peak was assessed by Bland-Altman plot.
Results
Linear regression revealed that the PACER (R2=0.86) and the 6MWD (R2=0.75) was significantly related to VO2 peak ($p<0.05$). Both the 16-metre PACER and the 6MWD significantly correlated with VO2 peak for adults with DS. The relationship was stronger for the 16-metre shuttle run test (r=0.87) than the 6MWD (r=0.78). The correlation between VO2 peak and both field tests, controlling for age, gender and BMI, remained significant ($r>0.7$; $p<0.05$). PACER, 6MWD and BMI are significant predictors of VO2 peak ($p<0.05$).
Conclusion
The 16-metre PACER and 6MWD are valid field tests for predicting aerobic capacity in adults with DS.

POSSIBILITIES AND LIMITATIONS OF THE PLAYSIGHT SMART COURT SYSTEM. DETERMINATION OF STROKE SPEED AND ACCURACY WITH THE PLAYSIGHT SMART COURT SYSTEM IN TENNIS.

STEIDL, C.1, LIEBHARDT, M.2, NOHA, B.2, FRÜHSCHÜTZ, H.1, SPITZENPFEIL, P.1
1:TU MUNICH, 2:BTV OBERHACHING

Introduction
Technology will have an increasing role in sports. It has changed how sports are coached, played, and consumed. The Playsight Smart Court System is a permanently installed camera analysis system, which is connected to the internet (Playsight, 2015). The aim of this study

was to identify possibilities and limits, to verify validity of the system, and to determine stroke speed and accuracy with the Playsight system in tennis.
Methods
36 kids at the age of 11 till 13 participate in the study and played one baseline and one serve exercise to identify differences in stroke speed and accuracy (number of hits). The baseline task contains one serie of ten forehands (FH) and backhands (BH) cross-court and down the line in a target zone (TZ), resulting in 40 strokes per participant according to Landlinger et al.,2012. The serve task consists of two series of ten serves in a TZ accomplished 'blocked' and 'alternated' at each side, resulting in 40 serves per participant. 'Blocked' means serving five times in a row to the T and five times in a row to the Wide. 'Alternated' means serving change between T and Wide after each serve. Spearman correlations were performed to determine relationships between ball speed and number of hits. Mann-Whitney U-tests were used to detect statistical differences in ball speed and number of hits between groups on groundstrokes and serves. Wilcoxon signed-rank tests were performed to determine differences between 'blocked' and 'alternated' serves.
Results
The error rate for line calls (2920 strokes) is 1.82%. Only in FH cross exists a negative correlation between speed (mean: 101.06 ± 8.9 km/h) and number of hits (mean: 6.56 ± 1.7; p=0.025, r=-0.37, R^2= 0.14). Differences between Advanced (AP) and Intermediate players (IP), as well as between younger and older kids in speed for all groundstrokes is given. Also between younger (middle rank: 20.76) and older kids (middle rank: 15.97) there is a difference in FH cross in the TZ. Concerning the serves there is no difference between blocked and alternated serving in speed and number of hits.
Discussion
The negative correlation in the FH crosscourt shows, those who played more powerful hit less in the target. In groups, the AP and the older kids hit the ball in each stroke more powerful than the IP and the younger kids. But the younger hit more strokes in the FH cross TZ than the older. The coach should decide the main focus in practice, if speed or ball security is more important in that age. In serves it is indifferent whether blocked or alternated. There are no differences in velocity or number of hits. In groups exists a difference in serve speed, that means the AP and the older kids serve more powerful. But the IP serve more numbers of strokes in the field and the younger serve more in the T from the right side.
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Contact
claudia.steidl@gmx.net

ASSESSING THE VALIDITY AND TEST RETEST RELIABILITY OF THE KINECT SENSOR WHEN SCORING THE FUNCTIONAL MOVEMENT SCREEN

SMITH, P., HANLON, M.
WATERFORD INSTITUTE OF TECHNOLOGY

Introduction
The Functional Movement Screen (FMS™) assesses an individual's movement patterns (Cook et al., 2006) but inter-rater reliability for FMS subtest scoring has been shown to be low (Shultz et al., 2013). The aim of this study was to assess the validity and test retest reliability of the Microsoft Kinect™ when scoring the FMS subtests.
Methods
The Microsoft Kinect™ was integrated with bespoke software (BS). Raw data from seven FMS subtests was captured and a data model created to identify movement errors against FMS scoring guidelines, providing scoring parameters for each subtest using kinematics from 20 joint centres. Twenty three healthy adults (mean age = 22.8±5.3 years) completed the seven FMS subtests. The Kinect was placed 4 m away in the frontal plane and at 1.75 m high. A blinded manual assessment was conducted by a certified FMS tester whilst the BS assessed each performance. The two scoring methods were compared to assess agreement and reliability levels using a weighted kappa (Kw) and standard error measurement (SEM). In addition, nine participants from the same cohort (mean age = 19.6±2.4 years) performed the seven subtests again one week later, to assess test retest reliability of the BS using intraclass correlation coefficient (ICC).
Results
Agreement between the two methods ranged from 78% for the trunk stability subtest (SEM=0.15), to 96% for the inline lunge subtest (SEM=0.14). Mean agreement across the seven subtests was 88% (SEM=0.25). Inter-rater reliability ranged from excellent for the hurdle step subtest (Kw=0.83) to moderate for the trunk stability subtest (Kw=0.47). Agreement was 39% for total FMS score (SEM=0.97) with moderate inter-rater reliability (Kw=0.61). Test-retest reliability for the BS ranged from good for the hurdle step subtest (ICC=0.78) to perfect for five subtests (ICC=1.00). Test retest reliability for total FMS score was excellent (ICC=0.97).
Discussion
The results suggest the Kinect has greater test retest reliability compared to manual assessment in previous research (Shultz et al., 2013), and has comparable agreement levels for subtest scoring, but lower agreement for total FMS score (Teyhen et al., 2012). The portable and inexpensive nature of the Kinect could offer an effective solution to conduct the FMS in applied settings.
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ONE METABOLIC EQUIVALENT IN POSTMENOPAUSAL OBESE WOMEN IS NOT EQUAL TO THE TRADITIONALLY ACCEPTED RESTING OXYGEN CONSUMPTION VALUE

KOŞAR, Ş.N., GÜZEL, Y., BULUT, S., ATAKAN, M.M., HAZIR, T., TURNAGÖL, H.H.
HACETTEPE UNIVERSITY

Introduction
Obesity is a common health problem in postmenopausal women due to the associated hormonal changes, decreased resting metabolic rate (RMR) and physical activity level. Accurate measurement of RMR and estimation of total energy expenditure are of great importance

in planning weight control and loss programs. The metabolic equivalent (MET) is generally used to determine the intensity and total cost of physical activity. One MET corresponds to 3.5 ml.kg-1.min-1 oxygen consumption (VO2) which is accepted as the RMR. As the basal metabolic rate changes with regard to several factors including age, adiposity, gender and physical activity level, the energy expenditure and VO2 equivalent to 1 MET may differ than traditionally accepted values in postmenopausal obese women (PMOW). Therefore, the purpose of this study was to compare the traditionally accepted value for 1 MET and direct measures of RMR in PMOW.
Methods
Fifteen PMOW (age: 57.3±3.7 years, Body mass index: 33.8±4.4 kg/m²) participated in this study voluntarily. RMR (kcal) was determined by indirect calorimetry (IC) (Quark K4b2) in supine position. Caloric equivalent of VO2 was determined by Weir's equation as well and used as the reference value. Body composition was measured by dual energy x-ray absorptiometry (DXA) on the same day and conditions. RMR also determined with Mifflin equation, which is widely used in obese population. One-Sample t-test, Paired-Sample t-test, Repeated Measures ANOVA and Pearson's correlation coefficient analyses were used for the analysis of data.
Results
Resting VO2 (1.82 ml.kg-1.min-1) was lower than commonly accepted value of 1 MET (3.5 ml.kg-1.min-1) ($p<0.01$). RMR determined by Weir equation (1062±61kcal) was higher than RMR by Quark (1047±60kcal) ($p<0.01$). RMR (1385±34kcal) predicted by Mifflin equation was higher than the RMR (1062±61kcal) determined by Weir equation ($p<0.01$). The associations between RMR by IC was positively associated with fat free mass ($r=0.52$, $p<0.05$), while the correlations between RMR, fat mass ($r=0.44$), soft lean mass ($r=0.50$) and BMI ($r=0.24$) were not significant ($p>0.05$).
Discussion
Resting VO2 value (1.82 ml.kg-1.min-1) was 48% lower than the traditionally accepted oxygen consumption value for 1 MET (3.5 ml.kg-1.dk-1). Although the RMR values determined by Quark and Weir equation were significantly different, the magnitude of the difference was not large. However, Mifflin equation overestimated the BMR in PMOW. In conclusion, resting oxygen consumption value in postmenopausal obese women is lower than the standard value of MET. Therefore, use of standard MET value of VO2 may overestimate the energy expenditure and lead to misclassification of physical activity intensities in postmenopausal obese women.

SELF- AND OBSERVER-RATED TALK TEST FOR EXERCISE PRESCRIPTION IN SEDENTARY SUBJECTS

THIEL, C., KLEEFISCH, T., KRAUSE, L., BRAUN, T., DEMIRCI, A., KOPKOW, C., GRÜNEBERG, C.

UNIVERSITY OF APPLIED SCIENCES

Introduction
The Talk Test appears to be a simple way of prescribing recommended exercise intensities, but it has rarely been tested in sedentary individuals who have no endurance training experience. It is also unclear how an outside observer rates the ability to speak as compared to the person exercising. The present study aimed to compare exercise intensities derived from an internal and an external rating of the Talk Test with reference intensities derived from lactate thresholds in untrained individuals.
Methods
Twelve healthy, sedentary subjects (8 female, 4 male; 34±11 years; BMI 27.2±5 kg·m−2; VO2max 30.1±4.6 ml· kg−1 ·min−1, corresponding to the 18th percentile for their age and sex) underwent a maximal oxygen consumption test, as well as a lactate threshold and Talk Test on a cycle ergometer on a separate day. During the last 20 seconds of each stage, subjects recited a standard text and rated speaking comfort. Concomitantly, an outside observer recorded his impression of the subject's level of speaking comfort.
Results
Based on subject rating, the last positive Talk Test stage (LP-TT:"still able to speak comfortably") occurred at 122±27% of aerobic lactate threshold (LT1: 93±23 Watt), 86±18% of individual anaerobic lactate threshold (LT2: 132±32 W) and 61±12% of peak aerobic power (Pmax: 184±44 W). The first equivocal TT stage (EQ-TT:"not sure") occurred at 148±22% of LT1, 103±17% of LT2 and 79±10% of Pmax. The first negative TT stage (N-TT: "not able to speak comfortably") occurred at 182±23% of LT1, 128±16% of LT2 and 92±10% of Pmax. Observer rating was 18±16% lower than subject rating at LP-TT ($p=0.01$) and 16±16% lower at EQ-TT ($p=0.01$). It tended to be 7±19% lower at N-TT ($p=0.176$). At self-rated LP-TT, 3 subjects exercised below LT1, 6 between LT1 and LT2, and 3 above LT2. At observer-rated LP-TT, 8 subjects exercised below LT1, and 4 subjects between LT1 and LT2.
Discussion
In order to perform a continuous endurance training on a cycle ergometer, sedentary people might choose the highest intensity which still allows them to speak comfortably . However, this results in considerable variability, with some individuals exercising below LT1, and some above LT2. If speaking comfort is rated by an outside observer, lower exercise intensities are elicited, but the variability of the resulting exercise intensities is still high. Future studies should assess whether combining the Talk Test with RPE enhances exercise prescription for subjects not accustomed to endurance exercise.

Saturday, July 8th, 2017

08:00 - 09:30

Invited symposia

IS-PM12 Muscle carnitine: the key player in muscle fuel selection?

INCREASING MUSCLE CARNITINE AVAILABILITY IN HUMANS AND ITS IMPACT ON MUSCLE FUEL SELECTION AND REGULATION IN EXERCISE AND HEALTH

STEPHENS, F.

UNIVERSITY OF EXETER

More than 95% of the body's carnitine pool is confined to skeletal muscle, where it fulfils metabolic roles in the regulation of both fat and carbohydrate oxidation, the major fuel sources utilised for mitochondrial ATP resynthesis during exercise. Firstly, as a substrate for carnitine palmitoyltransferase 1 (CPT1), carnitine facilitates the translocation of long-chain fatty acids across the otherwise impermeable mitochondrial membrane. Secondly, during high intensity exercise, carnitine buffers acetyl-CoA from excessive carbohydrate flux to acetylcarnitine, thereby maintaining a viable pool of free co-enzyme A (CoASH) to enable pyruvate dehydrogenase complex (PDC) flux and mitochondrial ATP resynthesis to continue. It is, therefore, not surprising that carnitine supplementation has been advocated as an ergogenic aid. This presentation will focus on studies that have increased skeletal muscle carnitine content in humans to provide insight into the importance of these metabolic roles. In particular, studies demonstrating that increasing skeletal muscle carnitine content by 15 to 20%, via 24 weeks of L-carnitine feeding in combination with an insulinogenic beverage, can increase fat oxidation and energy expenditure during low intensity exercise, and result in a greater acetylcarnitine accumulation and PDC activation during high intensity exercise. The implications of these metabolic effects for exercise performance and health will also be discussed.

Invited symposia

IS-PM14 Exercise Testing and Training in Clinical Populations - From High Performance Sports to Patients

EXERCISE TESTING IN CLINICAL POPULATIONS

SCHARHAG-ROSENBERGER, F.

NATIONAL CENTER FOR TUMOR DISEASES (NCT), UNIVERSITY HOSPITAL HEIDELBERG

In patients with cardiovascular diseases, cancer, and other chronic conditions, exercise training has positive effects on quality of life, symptoms, physical functioning, and probably even survival. To maximize the positive effects of exercise training, precise performance testing and training prescription are required. The present talk covers recently published aspects of exercise testing and intensity prescription in clinical populations.

Cardiopulmonary exercise tests using gas exchange or blood lactate measurements are considered the gold standard to assess cardiopulmonary fitness and derive aerobic exercise prescriptions. Thereby, the employed incremental/ramp protocols should be adjusted for low physical fitness levels (Klassen et al. 2014). In cancer patients, some methods of intensity prescription for healthy individuals result in either higher or lower exercise intensities than intended and should therefore not be used (Scharhag-Rosenberger et al. 2015). In terms of strength assessment, stationary dynamometer tests are usually considered a gold standard method. One of the advantages is that isometric and isokinetic tests can be performed early after surgery. However, they do not enable the determination of loads for machine-based training. Altogether, clinical exercise testing and training prescription require specific expertise that is discussed in the present talk.

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"HIT THE PATIENT" - STRENGTH AND ENDURANCE TRAINING IN CLINICAL POPULATIONS

HELGERUD, J.

THE NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

High intensity aerobic interval training, employing 4×4 min (rest and recovery intervals) as known from high performance football, is an effective approach to increase peak oxygen uptake (VO2peak) and cardiac stroke volume in different groups of patients (Helgerud et al. 2009 & 2011). Higher VO2peak is inversely associated with cardiovascular disease and, in turn, poor cardiovascular fitness is linked to a sedentary lifestyle with increased mortality risk (Myers et al. 2002). Similarly, low skeletal muscular strength is inversely and independently associated with increased mortality, even after adjusting for cardiorespiratory fitness and other potential confounders (Ruiz et al. 2008). Low muscular strength in clinical populations has been associated with reduced mechanical efficiency, the oxygen cost of a given general work load. The focus of strength training has shifted to neuromuscular adaptations that improve muscle strength with little or no change in muscle size (Heggelund et al. 2013). Maximal strength training using horizontal leg press in 4 series of 4 repetitions have been documented to be an effective treatment for several groups of patients (Hoff et al. 2007).

The present talk covers therapeutical consequences of HIT-based strength and endurance training for patients with coronary artery disease (CAD), peripheral arterial disease (PAD), chronic obstructive pulmonary disease (COPD), hip arthroplasty, schizophrenia, multiple sclerosis (MS) and stroke.
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AEROBIC EXERCISE INTENSITY PRESCRIPTION AND HIGH-INTENSITY LOW VOLUME EXERCISE IN DEPRESSIVE DISORDERS

DONATH, L.
UNIVERSITY OF BASEL

Depressive disorder is one of the leading cause of disability. Enormous direct and indirect health care costs result. Depressed patients show reduced physical fitness, cardiocirculatory, immune and autonomous function with a higher risk of cardiac diseases (Donath et al. 2010a). Aerobic exercise training evolved to a promising complementary treatment strategy for patients suffering from depression. However, appropriate aerobic exercise intensity determination recommendations are still lackling. This is of particular importance since intensity determination seems to differ between depressed and healthy subjects (Donath et al. 2010b). Adequate intensity prescription is, in turn, required to avoid an overstimulation of the stress axis. Besides various continuous aerobic exercise programs in the past, also high-intensity interval training has been beneficially applied to depressed patients. Recent studies also suggested high-intensity interval training at lower total training volumes for these patients (Herbsleb et al. 2014). The present talk provides an overview of physical dysfunction in depressed patients, with special emphasize on exercise intensity determination and training effects upon traditional aerobic exercise training. Then, recent high-intensity based training programs will be introduced and discussed. Finally, results of an ongoing study of an HILVE program on symptomatology, physical fitness and autonomous function will be presented (Donath et al. in prep).
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Oral presentations

OP-PM37 Training and exercise in clinical populations 3

IS BOUTED MODERATE-VIGOROUS PHYSICAL ACTIVITY ASSOCIATED WITH FIBROMYALGIA SEVERITY IN FEMALE FIBROMYALGIA PATIENTS? THE AL-ÁNDALUS PROJECT

SEGURA-JIMÉNEZ, V., ESTÉVEZ-LÓPEZ, F., CASTRO-PIÑERO, J., BORGES-COSIC, M., SORIANO-MALDONADO, A., ÁLVAREZ-GALLARDO, I.C., DELGADO-FERNÁNDEZ, M.
UNIVERSITY OF CADIZ

Introduction
According to the current physical activity guidelines, adults should engage in a minimum of 150 min/week of moderate-to-vigorous physical activity (MVPA) accrued in bouts of at least 10 min (Physical Activity Guidelines Advisory Committee, 2008). Therefore, we aimed to analyse the association of non-bouted MVPA and MVPA in bouts ≥ 10 min with fibromyalgia severity in females. Given that sedentary time (Segura-Jiménez et al., 2017) and physical fitness (Soriano-Maldonado et al., 2015) have shown a consistent association with the fibromyalgia severity, we also tested whether the association of non-bouted MVPA and bouted MVPA with fibromyalgia severity was independent of sedentary time and physical fitness.
Methods
In this cross-sectional study, 468 fibromyalgia females (51.5±7.6 years) participated. Sedentary time and MVPA (min/day) were measured using triaxial accelerometry through a 7-day period. Fibromyalgia severity was assessed with the Revised Fibromyalgia Impact Questionnaire. Physical fitness was assessed with the Senior Fitness test battery.
Results
Higher non-bouted total MVPA was associated with lower fibromyalgia severity (β=-0.185, p≤0.001); however, this association was no longer significant when sedentary time was included as covariate. Higher time in MVPA bouts was associated with lower fibromyalgia severity (β=-0.172, p<0.001) and this association was independent of sedentary time (β=-0.094, p=0.044) and physical fitness (β=-0.124, P=0.004). Patients meeting bouted PA guidelines displayed lower fibromyalgia severity than patients not meeting guidelines (mean difference=-12.6, P<0.001) and patients meeting non-bouted physical activity guidelines (mean difference=-6.3, p<0.001).
Discussion
Total time in MVPA performed in bouts ≥ 10 min was associated with fibromyalgia severity. Furthermore, the results suggested that accumulating MVPA in bouts ≥ 10 min acts through a different pathway than those of sedentary time and physical fitness. This supports the current physical activity guidelines, which recommend that MVPA should be accumulated in bouts ≥ 10 minutes. Longitudinal designs are warranted to corroborate the causality of these associations.
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Contact
victor.segura@uca.es

INFLUENCE OF A SIX-MONTH HIGH-INTENSITY EXERCISE INTERVENTION ON AUTONOMIC FUNCTION DURING EXERCISE FOR CHILDREN AND ADOLESCENTS WITH ASTHMA

MCNARRY, M.A.1, WADE, N.1, WINN, C.O.N.1,2, EDDOLLS, W.T.B.1, STRATTON, G.S.1, WILSON, A.M.3, DAVIES, G.A.2, MACKINTOSH, K.A.1

1APPLIED SPORTS TECHNOLOGY EXERCISE AND MEDICINE RESEARCH CENTRE, SWANSEA UNIVERSITY, 2SWANSEA UNIVERSITY MEDICAL SCHOOL 3NORWICH MEDICAL SCHOOL, UNIVERSITY OF EAST ANGLIA.

Introduction
Asthma has been associated with abnormal autonomic nervous system (ANS) control in adults, due to airway inflammation arising from hyper-reactivity in response to certain stimuli, such as exercise. However, little is known regarding the manifestation of these derangements in children and adolescents with asthma, or whether an exercise intervention can ameliorate such alterations in ANS control.
Methods
Thirty-three children with asthma (13.7±0.9 years; 21.9±3.9 kg·m2; 19 boys) and thirty healthy children (13.8±0.9 years; 20.3±3.2 kg·m2; 16 boys) completed an incremental ramp test and three heavy-intensity constant work rate cycle tests. A sub-sample of 13 children (6 asthma) participated in a six-month, three times a week, high-intensity interval training (HIIT) intervention (30 min sessions, 10-30 s exercise bouts at >90% age-predicted max heart rate, 1:1 exercise-to-rest ratio). Standard time and frequency domain indices of heart rate variability (HRV) were derived from the baseline, constant work rate and recovery phases of the exercise.
Results
Heavy-intensity exercise elicited significant alterations in HRV parameters, which largely failed to return to baseline values during the recovery phase. Specifically, increased exercise intensity was associated with a withdrawal of vagal tone and relative increase in sympathetic predominance within the context of a global reduction in HRV. No differences in HRV responses to exercise or during recovery were observed between those with and without asthma, although there was a trend for a decreased vagal component in those with asthma according to both time domain and power spectral density derived parameters. The intervention was not associated with any significant alteration in HRV parameters, irrespective of asthma status.
Discussion
The present findings therefore suggest that the derangements typically reported in the ANS function of adults with asthma are not manifest in children and adolescents. This may be indicative that such derangements are a function of disease progression or reflect the relatively mild severity of asthma in the present study. Furthermore, the present findings suggest that a six-month HIIT intervention does not represent an effective tool to enhance HRV parameters in children with or without asthma.

INTENSIVE LIFESTYLE INTERVENTION IN TYPE 2 DIABETES IMPROVES GLYCAEMIC CONTROL WITH USE OF LESS MEDICATION : A RANDOMISED, ASSESSOR-BLINDED, PARALLEL GROUP, CONTROLLED TRIAL

JOHANSEN, M., MACDONALD, C., HANSEN, K., KARSTOFT, K., CHRISTENSEN, R., PEDERSEN, M., HANSEN, S., ZACHO, M., WEDELL-NEERGAARD, A.S., NIELSEN, S., IEPSEN, U., LANGBERG, H., VAAG, A.

THE CENTRE OF INFLAMMATION AND METABOLISM AND THE CENTRE FOR PHYSICAL ACTIVITY RESEARCH, RIGSHOSPITALET, UNIVERSITY OF COPENHAGEN, COPENREHAB

Introduction
Lifestyle is the first line treatment of type 2 diabetes (T2D). However, it is unclear whether lifestyle may reduce or even replace glucose-lowering medication. The hypothesis was to test whether an intensive lifestyle intervention was equally effective in maintaining glycaemic control compared to standard care while being superior in reducing the need for glucose-lowering medication in patients with short standing T2D.
Methods
In a randomised, assessor-blinded, parallel group, controlled trial, patients (n=98) with short standing T2D (<10 years), aged >18 years and no diabetic complications were randomly assigned (2:1, stratified by sex) to either an intensive lifestyle (U-TURN) group or a standard care (StC) group. During 12 months, the U-TURN and StC participants received the same standard care with individual T2D counselling and an identical, standardised, blinded, target-driven medical therapy. Additionally, the U-TURN participants received partially supervised aerobic and resistance exercise sessions and dietary plans. Primary outcome was change in HbA1c at 12 months and equivalence was pre-specified by a margin of ±4.4 mmol/mol based on the intention-to-treat population. Superiority analysis was performed on reduction in glucose-lowering medication.
Results
In the intention-to-treat analysis, the U-TURN intervention decreased HbA1c compared to StC (between group mean change [95% CI] 2.9 mmol/mol; [0.1 to 5.7]; p=0.046). The U-TURN intervention was superior in reducing glucose-lowering medication corresponding to a number needed to treat of 2 (risk-difference [95% CI] 47% [29-65]). Secondarily, complete discontinuation of glucose-lowering medication was observed for 56% of the U-TURN versus 15% of StC participants (risk-difference [95% CI] 41% [25-59]).
Discussion
Intensive lifestyle intervention improves glycaemic control with parallel reduction or complete discontinuation of glucose-lowering medication.
Contact
mette.yun.johansen@regionh.dk

CARDIORESPIRATORY FITNESS IS ASSOCIATED WITH FATIGUE EVEN AFTER CONTROLLING FOR DEPRESSION IN PERSONS MULTIPLE SCLEROSIS

SEBASTIAO, E., MOTL, R.W.

UNIVERSITY OF ILLINOIS

Introduction
Fatigue is a prevalent, often debilitating manifestation of chronic inflammatory diseases of the central nervous system, including multiple sclerosis (MS). Many factors have been associated with fatigue in MS, including depression [1]. One commonly cited factor that is speculated to be associated with fatigue is cardiorespiratory fitness (CF). To this end, this study examined CF as correlate of fatigue, while controlling for depression, in people with MS.

Methods
Sixty-two ambulatory persons with MS participated and assessments were completed in a single session. CF was measured and expressed as peak oxygen consumption (VO2peak) using an incremental exercise test on a recumbent stepper (NuStep T5xr) and an open-circuit spirometry system (Parvo Medics' True OneR 2400) was used for analyzing gas exchange. Fatigue was measured using the Modified Fatigue Impact Scale, which provides a multidimensional assessment of fatigue by assessing the impact of fatigue on physical, cognitive, and psychosocial functioning [2]. The sum of these three components allow for the generation of a total fatigue score. Depression was assessed using the validated and reliable Hospital Anxiety and Depression Scale [3].
Results
The average age of participants was 52.1 (7.7) years and disability level was found to be moderate. After controlling for depression scores, CF remained inversely significantly associated with physical ($r = -.63$; $p < .001$), cognitive ($r = -.35$; $p = .005$), psychosocial ($r = -.54$; $p < .001$), and total fatigue ($r = -.57$; $p < .001$); meaning that those with low CF report higher levels of fatigue.
Discussion
Moderate-to-large correlations between CF and fatigue were observed in this sample. The findings suggest that CF may be a potential way to counteract fatigue in persons with MS. Future studies should test whether improvements in CF has a positive impact on fatigue in this population. This is important as fatigue affects about 80% of persons with MS, and this debilitating symptom negatively impacts participation, including self-care activities and tasks requiring physical effort, and consequently quality of life.
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Contact
esebast2@illinois.edu

ACTIVITY PACING, FATIGUE, PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR IN ADULTS WITH MULTIPLE SCLEROSIS: DATA FROM THE RESPACT STUDY

ABONIE, U.S.1, HOEKSTRA, F.2, HOEKSTRA, T.2, VAN DER SCHANS, C.P.2, DEKKER, R.2, VAN DER WOUDE, L.H.V.2, HETTINGA, F.J.1

1: CENTRE OF SPORT AND EXERCISE SCIENCE, SCHOOL OF BIOLOGICAL SCIENCE, UNIVERSITY OF ESSEX, UK 2: UNIVERSITY MEDICAL CENTER GRONINGEN, UNIVERSITY OF GRONINGEN, GRONINGEN, THE NETHERLANDS

Introduction
The incident of fatigue draws several behavioural adaptations in multiple sclerosis (MS) patients, such as reduced activity levels resulting from and in anticipation of fatigue (Van Kessel et al, 2006). Also, patients show an unevenly spread activity pattern throughout daily life, consisting of short activity peaks followed by long rest periods (Sutherland et al, 2001). Both patterns have been linked to disability (Hanson et al, 1990), yet little is known about the activity patterns of MS patients or how they engage in naturalistic pacing to manage their fatigue and optimize their daily activities. The aim of this study is to examine naturalistic pacing in persons with MS, and explore relations with fatigue, sedentary behaviour and physical activity.
Methods
65 MS patients (mean age= 45.53 ± 10.44yrs) filled in questionnaires on their pacing engagement and risk of overactivity (5-point Activity Pacing Questionnaire, consisting of those 2 components, as described in Alingh et al, 2015), fatigue (7-point Fatigue Severity Scale), sedentary behaviour (time spent sitting) and physical activity (time spent on activities adapted SQUASH) post rehabilitation, within the ReSpAct study. Spearman correlations were used to examine relationships between pacing engagement, risk of overactivity, fatigue, sedentary behaviour and physical activity.
Results
Mean pacing engagement, risk of overactivity, fatigue, physical activity and sedentary behaviour were 3.71 ± .74, 3.65 ± .89, 5.25 ± 1.27, 1128.60 ± 1030.58minutes/week and 3940.32 ± 2313.60minutes/week respectively. There were significant correlations between risk of overactivity and fatigue ($r = .23$; $p < .05$) and between fatigue and sedentary behaviour ($r = .38$; $p < .01$). Non-significant associations were found between pacing engagement and fatigue ($r = .19$; $p > .05$) and between pacing engagement and physical activity ($r = -.18$; $p > .05$).
Discussion
The results demonstrate that perceived risk of overactivity and fatigue and subsequent sedentary behaviour were linked. In terms of promoting physical activity, important for health and mobility, these findings provide interesting insights: more research is needed to explore how to engage persons with fatigue symptoms in an active lifestyle in such a way that fatigue symptoms are well-managed.
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Contact
usabon@essex.ac.uk

Invited symposia

IS-BN08 MUSCLE EMG ACTIVITIES IN SPORT SCIENCES

FROM MUSCLE SYNERGIES TO MUSCLE FORCE: TOWARD A BETTER UNDERSTANDING OF MUSCLE COORDINATION STRATEGIES

HUG, F.
UNIVERSITY OF NANTES

Due to muscle redundancy, one basic problem is to understand how muscles are coordinated to adequately perform common motor tasks. An understanding of muscle coordination is also important for rational planning of therapeutic intervention in clinical populations. It is also important for athletes so that the influence of various factors, such as the use of specific equipment or training intervention, can be better quantified. Both neural drive and its mechanical consequence (muscle force) must be considered together to gain a better understanding of muscle coordination strategies.
This talk will first discuss the concept of "muscle synergy" to study muscle coordination. This approach is used to decompose EMG patterns recorded from numerous muscles into the summed activation of just a few muscle synergies. As such muscle synergy analysis can offer insight into underlying neural control strategies of movement. Then, we will present recent experiments showing that elastography can be used to quantify change in force produced by an individual muscle. This experimental technique offers promising perspectives to quantify force sharing during various tasks.

MUSCLE INACTIVITY AND ACTIVITY DURING NORMAL DAILY LIFE

FINNI, T.
UNIVERSITY OF JYVASKYLA

Recent findings suggest that not only the lack of physical activity, but also prolonged times of sedentary behaviour where major locomotor muscles are inactive, significantly increase the risk of chronic diseases. By using novel EMG shorts with embedded textile electrodes measuring quadriceps and hamstring muscle inactivity and activity patterns during normal daily life of ordinary people we have shown that our main locomotor muscles are inactive over 7 hours, and only a small fraction of muscle's maximal voluntary capacity is used. Interestingly, people having low muscle inactivity time during their typical day have better HDL cholesterol and triglyceride profiles than people who have greater muscle inactivity time. In a randomized controlled trial where office workers were given one counseling session to reduce sitting time, the workers were able to reduce muscle inactivity time by 33 min, which was reallocated to 21 min of light muscle activity. The findings of the significance of low level muscle activities may be utmost important since even exercise for fitness may not reduce the daily sedentary time. The target audience of this lecture ranges from sports coaches who may use textile EMG technology in daily coaching purposes to researchers focusing on associations between physical activity and public health.

Oral presentations

OP-PM32 Endurance performance testing

PREDICTION OF PERFORMANCE BY HEART RATE-DERIVED PARAMETERS IN RECREATIONAL RUNNERS

IRAZUSTA, J., ETXEGARAI, U., INSUNZA, A., SANTOS-CONCEJERO, S., PORTILLO, E., LARRUSKAIN, J., GIL, S.M.
UNIVERSITY OF THE BASQUE COUNTRY

Introduction
Certain heart rate (HR)-derived parameters are predictors of endurance performance and are also used for prescribing and monitoring training intensities (Lamberts et al., 2010; Vesterinen et al., 2016). Despite this evidence, HR monitoring is still not accepted as a gold standard to predict performance. In the present work, we investigated whether HR-derived parameters are accurate performance predictors in endurance recreational runners.
Methods
An incremental running test with 1 minute of recovery between stages (4 minutes) was completed by 130 participants. At the end of each stage, HR, % of maximum HR (%HRmax), and blood lactate were recorded. We also assessed HR at the end of the recovery period (HRR), and calculated lactate and HRR thresholds and HR deflection point (HRDP). We tested these parameters for associations with running performance, as measured by peak treadmill speed (PTS) and personal best International Association of Athletics Federations (IAAF) score, using Pearson´s (r) or Spearman´s (rho) correlations and multiple linear regressions.
Results
The %HRmax at submaximal running speeds (13.5, 14.5 and 15.5 km/h) significantly correlated with lactate concentration (r = 0.76 to 0.82), lactate threshold (r = -0.66 to -0.77), PTS (r = -0.87 to -0.94), or IAAF score (rho = -0.78 to -0.81). The magnitudes of the correlations of lactate-related parameters with PTS (r = 0.79 to 0.87) or IAAF score (rho= 0.65 to 0.77) in absolute values were slightly lower. Weaker correlations were detected between other HR-derived parameters and running performance (r or rho = 0.33 to 0.70). Regression models identified %HRmax at a given speed as the strongest predictor of PTS (beta = -0.72) and IAAF Score (beta = -0.72).
Discussion
Our results demonstrated that %HRmax reached at a submaximal running speed was a better predictor of running performance in recreational athletes than the other HR-derived parameters. Even, it showed better predictive capacity for the IAAF score than lactate-derived parameters. Consequently, tests based on %HRmax may provide non-invasive and inexpensive methods for predicting the performance of recreational endurance athletes.
Acknowledgements
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HIGHER ACCURACY OF THE LACTATE MINIMUM TEST COMPARED TO ESTABLISHED THRESHOLD CONCEPTS TO DETERMINE MAXIMAL LACTATE STEADY STATE IN RUNNING

WAHL, P., ZWINGMANN, L., WOLF, J., BLOCH, W., MESTER, J.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
The maximal lactate steady state (MLSS) is generally regarded as the foremost indicator of aerobic endurance performance. Most existing single-session tests (graded exercise tests) use either fixed-[La] or inflection-point as determination criteria for MLSS. However, these criteria are arbitrary or empirically derived. The lactate minimum test (LMT) (Wahl et al., 2016) is the only single-session test which is based on the physiologically founded lactate appearance-disappearance equilibrium concept that forms the basis for the MLSS test, as well. Although the LMT seems promising and is physiologically justifiable, no study directly compared this approach with established threshold concepts for the determination of MLSS in running. The aim of the present study was to compare the accuracy of a LMT and established threshold concepts (OBLA & mDmax) for the determination of MLSS.
Methods
Eighteen subjects performed a LMT, a graded-exercise-test (2.4 m·s-1 start, +0.4 m·s-1 every 5 min) and 2 or more constant-speed tests of 30 minutes to determine running speed at MLSS. The LMT consisted of an initial lactate priming-segment (ramp test), with the aim to determine VO2max and to increase [La], followed by a short recovery phase. Afterwards, the initial load of the subsequent incremental-segment was determined individually and was increased by 0.1 m·s-1 every 120 sec. Lactate minimum was determined by the lowest measured value (LMabs) and a third-order polynomial (LMpol). After the graded exercise test OBLA and mDmax were determined.
Results
The mean difference to MLSS was +0.01 ± 0.14 m·s-1 (LMabs), 0.04 ± 0.15 m·s-1 (LMpol), -0.06 ± 0.31 m·s-1 (OBLA) and -0.08 ± 0.21 m·s-1 (mDmax), showing the lowest difference and the smallest limits of agreement for the LMT. The intraclass correlation coefficient (ICC) between running velocity at MLSS and LMabs was highest (ICC=0.964), followed by LMpol (ICC=0.956), mDmax (ICC=0.916) and OBLA (ICC=0.885). VO2max measured during the ramp tests was significantly higher compared to the graded exercise test (4.58 ± 0.58 vs. 4.42 ± 0.44 L·min-1).
Discussion
Due to the higher accuracy of the LMT to determine MLSS compared to OBLA and mDmax, we suggest the LMT as valid and meaningful concepts to estimate running velocity at MLSS in one single test for moderately up to well-trained athletes. Furthermore, the LMT revealed higher VO2max values, providing a more complete assessment of training status. Additionally, our LMT protocol does not require detailed knowledge of subjects' training status compared to previous LMT-protocols.
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Contact
Wahl@dshs-koeln.de

DIFFERENT EXHAUSTIVE PROTOCOLS AFFECT ESTIMATES OF CRITICAL SPEED AND D´

TRISKA, C.1, KARSTEN, B.2, NIMMERICHTER, A.3, TSCHAN, H.1
1: UNIVERSITY OF VIENNA (AUT); 2: UNIVERSITY OF GREENWICH (UK); 3: UNIVERSITY OF APPLIED SCIENCES WR. NEUSTADT (AUT)

Introduction
The relationship between distance and time is linear for exhaustive durations (tlim) >1 min and <40 min. Data points outside these limits deviate from the regression line and tend to overestimate critical speed (CS) and underestimate the maximum distance above CS (D´) (<1 min) or tend to underestimate CS and overestimate D´ (>40 min) (1). Therefore, the chosen predictive run durations affect CS and D´ (1,2). Whilst there is a general consensus on the number of predictive trials (at least 3) within an accepted exhaustive time band of 2 to 15 min, there is no such consensus on the exact tlim that should be used within this band. Therefore, the aim of the study was to assess the effects on CS and D´ of two protocols using different tlim within 2 to 15 min.
Methods
For the determination of CS and D´, 10 male endurance trained runners and triathletes (age: 31.0 ± 5.7 yrs; height: 1.81 ± 0.05 m; body mass: 76.5 ± 6.8 kg) performed two field tests. On both occasions, participants performed three exhaustive time trial (TT) runs. Protocol I consisted of a 12, 7, and 3 min exhaustive TT and Protocol II of a 10, 5, and 2 min exhaustive TT. Each TT was interspersed by 60 min passive rest and testing sessions were separated by at least 72 h recovery. D´ and CS were estimated using the following equation: Speed = D´/t + CS. A paired samples t-test was used to assess the differences between the protocols. Agreement between the protocols was assessed using the 95% limits of agreement (LoA). Pearson product correlation coefficient and the standard error of the estimate (SEE) assessed the relationship between the protocols. Effect size was calculated using Cohen's d.
Results
Between protocols there was a significant difference for estimates of CS (4.17 ± 0.37 m/s vs. 4.29 ± 0.30 m/s; P=.03; d = .30), but no significant difference for estimates of D´ (144.8 ± 29.6 m vs. 124.4 ± 25.0 m; p= .12; d = .74). Significant correlations were found for CS (r=.93; SEE = .11 m/s), but not for D´ (r=.05; SEE = 26.5 m). The 95% LoA for CS and D´ were ±0.31 m/s and ±62.7 m respectively. Even within the recommended time band a shorter protocol results in faster and shorter values of CS and D´ respectively. Despite the significant difference, the effect is of a small order. Applying the resultant two mean values of CS in a practical setting results in notably different calculated 5-km performances (mean difference: 30.8 s; p = .03). To reduce measurement error it is consequently recommended to consistently use the same TT testing protocol when monitoring CS and D´.
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Contact
christoph.triska@univie.ac.at

COMPARIBILITY OF COMMON POOL TESTING PROTOCOLS FOR OPEN WATER SWIMMERS

PYNE, D., WALLETT, A., MCKEON, R., SHAW, G.
AUSTRALIAN INSTITUTE OF SPORT

Introduction
Open water swimming is a specialist (endurance) aquatic program that features at both the Olympic Games and Fédération Internationale de Natation (FINA) competitions. However relationships between common pool-based training and fitness test sets in this cohort of swimmers, who compete over a 10 km race distance, are not well described. The aim of this study was to quantify differences in derived swimming speeds between common open water swimming training and tests covering a range from 1000 – 4000 m in total volume.
Methods
National Open Water Squad swimmers (7 males, 5 males aged 18-23 y) undertook on different days at a training camp the following pool-based tests: a 2000-m time trial, a 10 x 400-m progressive incremental step test, and a prescribed training set of 10 x 100-m. Performance in each of the three tests was converted to mean s.100 m-1 and log-transformed before analysis. Linear regression analysis was used to estimate swimming velocity at the fixed blood lactate concentrations of 4 and 6 mM. A student's t-test was used to assess differences in mean swimming velocities between swimming tests.
Results
The maximal effort 2000TT yielded a mean velocity of 63.4 ± 2.2 s.100 m-1 which was similar to the 6mM speed from the 10 x 400-m step test (64.1 ± 2.0), but substantially faster (1.08, ±0.28; standardised difference, 90% confidence limits) than the 4mM threshold speed (66.1 ± 2.2). The prescribed training set yielded a mean velocity of 63.8 ± 2.4 s 100.m-1 closer to the 6 mM threshold velocity and 2000TT, than the 4 mM threshold velocity.
Discussion
Both the 2000TT and maximal aerobic training yielded substantially faster speeds (~3-5% or ~2-3 s 100.m-1 faster) than the 4 mM threshold from the 10 x 400-m step test. Coaches and scientists should be conversant with the range and order of training speeds from a metabolic perspective (Toubekis and Tokmakidis, 2013). A narrow range of submaximal speeds (lactate threshold, maximal lactate steady state and critical velocity) in this cohort of open water swimmers is consistent with an earlier report on moderately well-trained swimmers (Greco et al., 2013). However derived estimates of training speeds in the range of lactate threshold to maximal aerobic are not directly interchangeable. Common pool-based fitness testing protocols can provide a systematic means of evaluating changes in fitness and for prescribing training sets.
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Contact
david.pyne@canberra.edu.au

ESTIMATING SUBMAXIMAL AND PEAK OXYGEN UPTAKE BASED ON POSTEXERCISE MEASUREMENTS IN SWIMMING

CHAVERRI, D.1, IGLESIAS, X.1, SCHULLER, T.2, HOFFMANN, U.2, RODRÍGUEZ, F.A.1
1: INEFC, UNIVERSITAT DE BARCELONA (SPAIN), 2: GERMAN SPORTS UNIVERSITY COLOGNE (GERMANY)

Introduction
In swimming, oxygen uptake (V'O2) was often estimated using postexercise measurements. A time delay at the onset of the V'O2 recovery curve (Di Prampero et al., 1973) may cause an overestimation when backward extrapolation (BE) methods are used (Lavoie et al. 1983), or an underestimation if a 20-s single measurement is utilized (Chaverri et al., 2016) at high intensities. Better results were reported using a heart rate HR-V'O2 modelling procedure (Chaverri et al. 2016; Rodríguez 2017). This study aims to compare direct V'O2 measurements during sub- and supramaximal swims with the most commonly used procedures to estimate V'O2 using postexercise measurements.
Methods
14 elite swimmers performed 3x200-m front crawl swims at increasing submaximal speeds (0.9, 1.0, and 1.1 m/s) and, in a separated session, a 200-m all-out swim. V'O2 was measured breath by breath (K4 b2, Cosmed) and HR beat by beat (CardioSwim, Freelap), 1 min before, during, and 3 min postexercise. V'O2sub(-20–0) and V'O2peak(-20–0) was the average of the last 20 s of effort in the submaximal and maximal tests, respectively, and were used as criterion values. Postexercise measures were compared for both intensities: 1) first 20-s average [V'O2sub(0–20); V'O2peak(0–20)]; 2) linear and semilogarithmic BE of the first 3 or 4x20-s averages [BEsub; BEpeak; LOGsub; LOGpeak]; and 3) predicted values using HR-V'O2 mathematical modelling [pV'O2sub(0–20); pV'O2peak(0–20)]. RM-ANOVA and post-hoc Bonferroni tests compared exercise and estimated V'O2 differences ($p<0.005$).
Results
For supramaximal swimming, criterion V'O2peak(-20–0) (2985±430 ml/kg·min-1) was different from all estimated parameters ($p<0.015$) except pV'O2peak(0–20) (3020±461 ml/min-1; mean diff. 1.1%, $p>0.99$). For submaximal intensity, V'O2sub(0–20) (1780±246 ml/min-1) was the only value differing from the criterion V'O2sub(-20–0) (1935±232 ml/min-1). The HR-V'O2 modelling offered the best estimation: pV'O2sub(0–20) (2022±274 ml·min-1; mean diff. 4.3%, $p>0.68$).
Discussion
Our results confirmed the validity of BE methods to estimate V'O2 from postexercise measurements, also after submaximal intensities (Léger et al. 1980). The HR-V'O2 model previously reported to be the most valid and accurate procedure to estimate V'O2 in supramaximal swimming (Chaverri et al. 2016; Rodríguez et al., 2017) has shown good accuracy also in submaximal intensities.
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Contact
chaverri.diego@gmail.com

CRITICAL VELOCITY RELATIONSHIP TO VENTILATORY GAS EXCHANGE PARAMETERS AND MAXIMAL LACTATE STEADY STATE IN SWIMMING

ESPADA, M.1,2,3, PESSOA FILHO, D.2, ALVES, F.3

(1) POLYTECHNIC INSTITUTE OF SETUBAL / (2) LABOREH LABORATORY OF HUMAN PERFORMANCE SPORTS OPTIMIZATION, UNESP / (3) FACULTY OF HUMAN KINETICS - UNIVERSITY OF LISBON

Introduction
It is acknowledged that the evaluation of physiological measures provide fundamental information for training prescription, monitorization and performance maximization. Maximal lactate steady state (MLSS) has been described as the gold standard for aerobic training prescription and critical velocity (CV) associated to the boundary between the heavy and severe exercise intensity domains. The respiratory compensation point (RCP) seems to be close to the lower boundary of the severe-intensity domain in swimming exercise indicating that it is possible that the maximal oxygen uptake (VO2max) might be attained in this exercise intensity. The aim of this study was to examine the relationship between CV, MLSS and ventilatory gas exchange parameters in swimming.
Methods
Twelve male competitive swimmers (18.6±3.4 years of age) completed an incremental test composed by 5x250m and 1x200m front crawl for gas exchange threshold determination through Log-log and Dmax methodology, RCP and VO2max, as well as the respective swimming velocities (SV). MLSS was determined from the traditional methodology (30-min at constant velocity at 85, 90 and 95% of MAV, previously determined). In all these tests, VO2 was directly measured using a telemetric portable gas analyzer (K4b2, Cosmed, Rome, Italy). CV was calculated without VO2 measurement from the slope of distance-time relationship from maximal trials performed in training environmental and the respective covered distances (100, 200, 400 and 800 m). Pearson's product–moment correlation coefficient was used to establish correlations. Paired-samples t-test was used to compare swimming parameters and variables. Statistical significance was set at $p<0.05$.
Results
CV200-400 (1.41±0.05 m.s-1), CV200-400-800 (1.39±0.05 m.s-1) and CV100-200-400-800 (1.39±0.05 m.s-1) overestimated vMLSS (1.30±0.04 m.s-1), which in turn, was significantly correlated with vRCP (1.31±0.09 m.s-1) ($r=0.81$, $p<0.01$) and vDmax (1.30±0.04 m.s-1) ($r=0.83$, $p<0.01$), all these SV were not significantly different. RCP (49.4 ± 6.7 ml.kg-1.min-1) was not significantly different from VO2 at vMLSS (49.0±8.9 ml.kg-1.min-1), both were significantly different from VO2max (57.4±7.1 ml.kg-1.min-1). vVO2max (1.45±0.04 m.s-1) was significantly correlated to vDmax (0.87, $p<0.01$), vMLSS (0.83, $p<0.01$) and vRCP (0.62, $p<0.01$). All CV determinations were correlated to vDmax and vVO2max but no correlations were observed with vRCP.
Discussion
These findings indicate that CV does not provide an accurate estimation of the physiological parameters traditionally associated to the transition from the heavy to the severe exercise intensity domain in swimming, namely vRCP and vMLSS. It could be argued that vMLSS can be indirectly estimated through an incremental test and the swimming distances used for CV determination should be carefully selected.

Invited symposia

IS-SH09 The psychology of judgments and decision-making in sport and exercise

THE POWER OF SIMPLICITY: WHY LESS-IS-MORE IN SPORT AND EXERCISE CHOICES

RAAB, M.

GERMAN SPORT UNIVERSITY COLOGNE

Judgments and choices and sport and exercise differ on many dimensions. Here I will focus only on the choices and judgments of athletes operating with limited time available. One approach that proposes that considering less information (cues) or fewer alternatives when making such complex athlete choices such as to whom to pass the ball is the fast-and-frugal heuristics approach. According to this approach, experts learn to rely on heuristics in an adaptive way in order to make accurate decisions. We test the adaptive use of heuristics in three ways: the descriptive study of the heuristics in the cognitive "adaptive toolbox;" the prescriptive study of their "ecological rationality," that is, the characterization of the situations in which a given heuristic works; and the engineering study of "intuitive design," that is, the design of transparent aids for making better decisions. I will provide examples for discrete choices as well as examples from sequential choices that illustrate when relying on your intuition is beneficial.

THE POWER OF PARALLEL PROCESSING: EXPERTS USE OF MULTIPLE CUES IN AN INSTANT

PLESSNER, H.

UNIVERSITY OF HEIDELBERG

So called multiple-cue approaches to judgment and decision making generally highlight people's ability to make decisions by assessing multiple features of the decision making situation. According to these approaches, the ability to process multiple cues in a parallel fashion and to draw valid conclusions even under time pressure can be considered as an important factor of decision makers' expertise. Consequently, the value of multiple-cue approaches for the understanding of expert performance in sport has been recognized in various studies on athletes' decision making in recent years. In addition, our own work focused on referees' decisions in sports like soccer and basketball. Among others, the application of a multiple-cue approach in this area turns the attention to the question of how referees can be supported in their learning of valid cue-criterion correlations. This talk provides an overview on respective training studies and discusses multiple-cue probability learning as a general framework for improving decision making in sport.

THE NEED TO TAKE COMPLEXITY AND CONTEXT OF DECISION-MAKING INTO CONSIDERATION

MACMAHON, C.
SWINBURNE UNIVERSITY OF TECHNOLOGY

Little previous work has examined the reciprocal relationship between cognition and speed of movement through a sports judgment and decision making lens. Recent explorations, however, have shown that the movement characteristics of stimuli, and the physical movements of a decision maker may have an impact on the associated decisions and judgments. First, the effects of using speeded video stimuli on complex sports decisions will be presented. This work shows the benefits of training with fast-speed videos for elite sports performers. Second, I will discuss how the decision-maker's own speed of movement has an impact on thinking speed and explorations of subsequent risk-taking behaviour. These effects and related areas of work will highlight the need to take the complexity and context of decision making into greater consideration when examining sports judgements, and to continue to push ourselves to move beyond the relatively simple foundations in this work. Future directions will also be discussed, with implications for testing, training, and theoretical frameworks.

Oral presentations

OP-BN15 Modeling sports performance

THE LINEAR MIXED MODEL TO THE RESCUE: WHEN YOUR DATASET DOESN'T MEET THE ASSUMPTIONS OF A REPEATED MEASURES ANOVA

WELVAERT, M.1,2, BURKE, L.M.2, WOLLIN, M.2
UNIVERSITY OF CANBERRA

Introduction
Within-subject designs are a common paradigm in Sport Science. Traditionally, these designs are analysed using a Repeated Measures ANOVA (RM-ANOVA). However, the assumptions of this analysis pose restrictions on the data and design characteristics. Unbalanced designs, missing or non-normal data create issues for the RM-ANOVA. We present two case studies (CS) in which LMM analysis provided a solution in this instance.
Methods
CS 1: 10km race walking results collected during two training camps as part of a diet intervention study (Burke et al. 2016) did not meet the requirements for RM-ANOVA because of missing data and partial cross-over of subjects between conditions. Race conditions were also substantially different between camps, potentially masking the effects of the diet intervention.
CS 2: Pain measurements on a 0-10 rating scale related to groin health collected over the course of a football tournament (Wollin et al. 2017) were heavily skewed with an overrepresentation of no pain reports, violating the normality assumption of the RM-ANOVA.
All analyses were carried out using R (R Core Team, 2016) with the lme4 (Bates et al. 2015) and glmmADMB (Fournier et al. 2012) packages.
Results
CS 1: A crossed random effects LMM was successful in distinguishing variability due to different race conditions and heterogeneity between subjects, providing an estimation of the diet intervention effects.
CS 2: A Generalized Negative Binomial Zero-Inflated LMM accounted for the overrepresentation, while simultaniously modelling the mechanism of reported pain levels.
Discussion
Our case studies demonstrate that the LMM offers tremendous opportunities. Our recommendation is that this approach should be considered for within-subject designs, in particular for unbalanced designs.
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Contact
Marijke.Welvaert@canberra.edu.au

PRELOAD FOR A MORE REASONABLE PERFORMANCE PREDICTION WITH THE FITNESS FATIGUE MODEL

LUDWIG, M., ASTEROTH, A.
HOCHSCHULE BONN-RHEIN-SIEG, UNIVERSITY O.A.S.

Introduction
The Fitness Fatigue model is often used for performance analysis. It uses an initial basic level of performance and two antagonistic terms: a fitness-term and a fatigue-term. By fitting the models parameters, we adapt the model to the subject's individual physical response to strain. Even though in most cases fitting of recorded training data shows useful results, without modification the model cannot be simply used for prediction.
Methods
In this study, we used data of five elite swimmers (17-27y, 1f/4m) previously presented by Rasche, Endler and Pfeiffer (2016). Data was recorded over 25 weeks where training load was computed by swimming kilometers weighted according to different stress levels (intensity). Each swimmer performed Semi-Tethered-Tests (3x20m freestyle, increasing resistance) twice a week, indicating the actual person's

performance level. Data analysis was performed with different versions of the Fitness Fatigue model: 1. the four parameter version (FF model 1) (Busso et al., 1994); 2. FF model 1 where the initial performance level, p*, is set on the first real measured value (FF model 2); 3. an adaptation of FF model 1 with preload (FF model 3) as presented in Ludwig & Asteroth (2016); 4. a version with variable dose response (FF model 4) (Busso, 2003). Model parameters are fitted on the first 50% of the performance data and used to predict performance of the second half of data. Mean absolute percentage error (MAPE) is computed to compare prediction quality to measured performance values of different methods used.
Results
Prediction results of the average MAPEs ± standard deviation are as follows: 4.24 ± 2.86% for FF model 1; 6.27 ± 5.70% for FF model 2; 3.73 ± 2.98% for FF model 3; and 4.40 ± 2.60% for FF model 4.
Discussion
The assumed initial performance value p* is of great relevance for performance prediction. If p* remains unchanged, prediction of a performance time series starts at the same level as data fitting before any training. If p* is set on the last known performance value from fitting or the first new value, and prediction starts from this value, performance loss cannot be properly predicted. The preload concept improves performance quality, letting p* unchanged but taking past training effects into account.
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Contact
melanie.ludwig@h-brs.de

MIXED LINEAR MODELLING OF TRAINING-PERFORMANCE RELATIONSHIP IN ELITE SWIMMERS

RODRÍGUEZ, F.A.1, SUSÍN, A.2, CALLE, M.L.3, CHAVERRI, D.1, IGLESIAS, X.1
1: INEFC-UB (BARCELONA, SPAIN), 2: UPC (BARCELONA, SPAIN), 3: UVIC-UCC (VIC, SPAIN)

Introduction
Despite refinements in modelling techniques, systems models have been unable to consistently predict performance on an individual in a real-world setting (Taha & Thomas, 2003). This study aimed to evaluate the modelling of the dose-response relationship between quantified training and performance with linear mixed-effects regression analysis (MixMod) in high-level competitive swimmers.
Methods
10 international-level swimmers completed an 8-week training mesocycle. Training load was quantified using the cummulative training impulse (TRIMPc) (Garcia-Ramos et al., 2015). Performance was measured in 3 time trials: 50, 100 or 200, and 400 m. Two modelling procedures were used: 1) the Banister-Busso (Busso 2003) individual linear regression model (LinMod), and 2) a novel linear mixed-effects regression analysis model (MixMod), in which the fixed-effects parameters provide the general or sample pattern while the random-effects parameters provide the individual specific behaviour. The Akaike Information Criterion (AIC) was used as information criteria for model comparison. The mean absolute percentage error (MAPE) was used to assess the relationship between estimated and observed performance. The "leave-one-out" cross-validation technique (LOO-CV) was used for internal validation. The overfitting of the model was estimated from the ratio RSS(LOO-CV)–RSS(Apparent)/RSS(LOO-CV). Significance level was set at $P < 0.05$.
Results
The estimated parameters provided fairly good agreement between observed and predicted performances in most individuals using the LinMod (MAPE=6.6%), as well as using the MixMod (MAPE=6.8%). However, MixMod (17%) showed a much lower level of overfitting compared to LinMod (87%).
Discussion
Our results proved that the usual strategy for fitting the classical Busso-Banister model can be affected of an extreme overfitting. This arises from the high number of observations per parameter needed (ca. 60 performance data points per individual). Another important limitation is that the adjustment is performed ignoring the correlation between the different observations on the same individual. The MixMod approach reduces considerably the overfitting because the time parameters are common for all individuals, and the individual predictions are jointly estimated using the information on all individuals, which allows the estimation of the general population behaviour through the fixed-effects parameters.
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Contact
farodriguez@gencat.cat

PERFORMANCE PREDICTION USING ANTAGONISTIC MODELS IN ROWING

RASCHE, C., ENDLER, S., PFEIFFER, M.
JOHANNES GUTENBERG UNIVERSITY MAINZ

Introduction
In training science, many attempts have been made to model the individual load-performance relationship of athletes using antagonistic performance models. These systems models abstract real-world settings and underlying physiology, while training load is typically merged into a single variable, so that vital information regarding the type of training is lost (Taha & Thomas, 2003). Furthermore, past research predominantly focused on simulation accuracy, whereas a comprehensive comparison of the predictive abilities has not yet been carried out (Clarke & Skiba, 2013). The Performance-Potential-Double-Model (PerPot DoMo; Perl & Pfeiffer, 2011) incorporates a second input variable and is compared to the existing performance models regarding its simulation and predictive accuracy.
Methods
Internal training load and performance of four elite rowers (17-25y, 2f/2m) was monitored for 16 weeks. The heartrate derived modified TRIMP (Garcia-Ramos, A. et al., 2015) was used as a sole input for the Fitness-Fatigue-Model (FF-Model) and the Performance-Potential-

Model (PerPot), whereas the training duration (volume) and TRIMP per minute (intensity) functioned as inputs for the PerPot DoMo. Performance was assessed via mean velocity of a weekly 1000m all-out trial on a rowing machine ergometer and used as the output variable for all three models. Mean absolute percentage error (MAPE) and coefficient of determination (r^2) of the simulated versus empirical performances were computed to estimate the model-fit of (i) overall data set, (ii) initial ten weeks (calibration) and (iii) last six weeks (prediction on the basis of the calibration).
Results
Resulting mean MAPE±SD and mean r^2 for the FF-Model, PerPot and PerPot DoMo correspondingly were: (i) 0.74±0.46% / .46; 0.39±0.18% / .66; 0.32±0.17% / .76; (ii) 0.64±0.35% / .56; 0.32±0.28% / .83; 0.18±0.15% / .95 (iii) 0.87±0.55% / .37; 1.07±0.63% / .31; 0.82±0.69% / .38.
Discussion
All three models obtain excellent model-fits for phases (i) and (ii), while precision declines regarding the prediction of future performances (iii). Two separate inputs (volume/intensity) enable PerPot DoMo to model performance slightly more precisely than with one input (FF-Model, PerPot) for (i) and (ii). Additional research is required to refine the models further to improve their predictive abilities, which includes the interpretation as well as technical details of the model's parameters.
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INDIVIDUALIZED DETECTION OF FATIGUE AND RECOVERY USING MULTIVARIATE DATA

PITSCH, W., HECKSTEDEN, A., MEYER, T.
SAARLAND UNIVERSITY

Introduction
Recently, Hecksteden et al. (2017) had demonstrated how thresholds for individualized decisions on (muscle) fatigue and recovery can be determined by using Bayesian statistics.
Methods
The method builds on a logic which is similar to the biological passport in Anti Doping. The individualized thresholds provided more sensitive and by the same time more specific decisions compared to group based or population based decisions when used to detect fatigue and recovery among athletes from endurance sports.
Results
The logic, which has so far only been demonstrated for univariate models can by principle be expanded to multivariate models. This would also allow to apply the method to more complex patterns of athletic performance like e.g. in games or in combat sports. The development of the statistical method will be demonstrated. Furthermore, this method will be calibrated using multivariate data from a sample of higher league soccer football players. The decision quality will be compared between individualized univariate and individualized multivariate thresholds.
Discussion
This will build the basis for the discussion of the possible trade-off between decision quality on the one hand and on the other hand the question, how complex and how comprehensible a decision basis for practitioners and scientists ought to be.
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THE PREDICTION OF DISADAPTATION STATE OF CARDIOVASCULAR SYSTEM IN ELITE ATHLETES FOR THE PREVENTION OF CARDIOVASCULAR DISEASES

ARUTYUNOV, Y., DROBYAZKO, A., KOSHKIN, D., SHASHOK, P., STASCHUK, K.
FEDERAL RESEARCH AND CLINICAL CENTER OF SPORTS MEDICINE AND REHABILITATION

Introduction
The functional state of an athlete's body systems is characterized by three parameters: the adaptive capacity of the body to physical loads ('athlete's health'), 'athlete's' performance' as a result of trainings and "active loads" itself. At the same time, disadaptation state is characterized by the inability of the body's systems to keep the athlete to adapt systems to stress and, as a result, to achieve the desired level of performance. The article presents a prognostic methodology for prediction of disadaptation state of cardiovascular system (CVS) in elite athletes. Here we present the results of application of this methodology for elite athletes.
Methods
The presented methodology includes three important aspects: quantitative description of CVS disadaptation state itself based on diagnostic parameters of CVS obtained from in-depth medical examination (DME); risk assessment for disadaptation state based on DME results; the assessment of possible time interval for occurring of disadaptation state.
Results
The developed method was tested on athletes of Russian National Teams. One of our studies involved 19 athletes (men) from cross-country skiing team. We aimed to determine the risk factors which are not included in diagnostic criteria for assessment of diseased state (not taken into account during DME and permission to training and competition), which may be the risk factors for CVS disadaptation state. The statistical analysis of database revealed the mean values, dispersion and 2-sigma intervals (the interval of reliability). The risk parameters were also identified. It was shown that among athletes which are eligible for training and competitive loads, there are those who may be in risk group for CVS disadaptation state. Another study involved 12 athletes (women) from speed skating team. It was shown that the breach of normal thickness of left ventricular wall and cardiac output may lead to CVS disadaptation state. By using variability methods the mean values, dispersion and coefficient of variability of left ventricular wall and cardiac output was determined. It was shown that in the group of athletes eligible for training and competitive loads, there are those whose risk for developing of disease is different from zero when variability of CVS parameters is 5-10 percent.
Discussion

The assessment of risk factors for CVS disadaptation state is very crucial for revealing possible CVS diseases and further permission of athlete to training and competition process.

Oral presentations

OP-PM56 Sleep: The good and the bad

SLEEP AND RECOVERY IN AN ELITE SUPER RUGBY UNION TEAM.

DUNICAN, I., HIGGINS, C., JONES, M., CLARKE, M., MURRAY, K., DAWSON, B., O'DELL, T., MADDISON, K., CALDWELL, J., HALSON, S., EASTWOOD, P.

UNIVERSITY OF WESTERN AUSTRALIA

Introduction
Sleep is increasingly recognised as being an essential component of performance and recovery in athletes (Gupta, Morgan, & Gilchrist, 2016). However, sleep can be negatively affected by stressors associated with competition, training and due to ergogenic aids, such as caffeine, or by the presence of sleep disorders. It is possible that many of these factors could be present in professional rugby players (Dunican & Eastwood, 2016). This research aimed to: (1) quantify the prevalence of sleep disorders in professional Super Rugby players; (2) assess the sleep habits of players during a week of a Super Rugby home game; and (3) describe caffeine use during an evening home game.
Methods
A series of studies were undertaken in professional Super Rugby players to determine: (1) the prevalence of sleep disorders in 25 players using comprehensive laboratory-based sleep studies (polysomnography); (2) sleep/wake patterns in 36 players using 7 days of continuous wrist actigraphy when at home, including game night; and (3) game-related caffeine levels in 23 players by collecting saliva samples before and after an evening home game. All players completed sleep/training diaries and sleep-related questionnaires (incl. Epworth Sleepiness Scale). Linear mixed modelling was carried out using R package and $p<0.05$ was considered statistically significant for all tests.
Results
Periodic limb movement disorder and sleep apnoea syndrome (apnoea hypopnea index >5) were evident in 16% & 20% of players respectively, and 35% reported having excessive daytime sleepiness. On game night, players went to bed later (02:20± 1:54hr vs 22:57± hr. mins, $p<0.001$) and had decreased sleep duration (361±71 vs 459±78 mins, $p<0.05$) compared to non-game nights. Post-game caffeine saliva concentrations were substantially greater than pre-game levels (0.40 vs 2.77ug/ml, $p<0.001$).
Conclusion
The prevalence of sleep disorders and daytime sleepiness is very high in Super Rugby players. Caffeine consumption prior to and during a Super Rugby game, resulted in markedly increased post-game saliva caffeine levels, which may contribute to the observed delay in time of sleep onset and reduced sleep duration on the night after an evening game.
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Contact
ian.dunican@research.uwa.edu.au

SELF-REPORTED SLEEP CHARACTERISTICS OF TRIATHLETES COMPETING IN THE 2015 IRONMAN® WORLD CHAMPIONSHIP

PAHNKE, M., BARNES, K., REIMEL, A., CARTER, J.

GATORADE SPORTS SCIENCE INSTITUTE

Introduction
Ultra-distance triathletes often report large training volumes when preparing for long-distance triathlons due to the event duration, ~8 – 17 hours, as well as the need to train for three different sport disciplines. Due to this issue, the chance for poor sleep habits and/or quality may result. The purpose of this study was to understand the sleep characteristics of competitive ultra-distance triathletes and the relationship with race performance.
Methods
30 triathletes (8 female, 22 male) competing in the 2015 IRONMAN® World Championship (Kailua-Kona, Hawaii, USA) participated in this investigation. The triathletes (age: 39.8 ± 6.6 y, range: 24 - 65 y) had been competing for 7.0 ± 6.6 y (range 1 – 26 y) and previously completed 8.1 ± 7.5 IRONMAN® distance triathlons prior to the championship with a personal best time of 10:24 ± 1:30 h:min (range: 8:46 – 14:32 h:min). All athletes completed the Pittsburgh Sleep Quality Index (PSQI) one to three weeks prior to the race. The PSQI is a 19 item validated questionnaire to assess several aspects of sleep habits and quality. Self-reported responses are utilized to calculate a global PSQI score to assess sleep quality during the month prior to the race. Poor sleep quality is indicated by a global PSQI score > 5.
Results
Triathletes completed the 2015 championship race in 11:42:26 ± 1:48:57 h:min:s (range: 9:01:38 – 16:31:29 h:min:s). The triathletes self-reported that they went to bed at 21:35 ± 1:02 h:min and awoke at 5:47 ± 1:16 h:min, with a self-reported sleep time of 6:59 ± 0:05 h:min. Time to fall asleep was 17 ± 14 min. The calculated global PSQI score was 6.0 ± 2.7. Sixteen of the thirty subjects had a PSQI greater than five, indicating poor sleep quality. Global PSQI score was positively correlated to age-group race finish percent rank in the 2015 world championship race ($r = 0.37$, $p < 0.05$).
Discussion
More than half of the experienced triathletes in this investigation that were competing in the 2015 IRONMAN® World Championship self-reported poor sleep quality as indicated by the PSQI. Sleep quality was significantly positively related to their age-group finish place in the event indicating that poor sleep quality was associated with a worse age-group rank. Additional research on ultra-distance triathletes via methods like sleep actigraphy is warranted to further understand their sleep habits, quality, and relationship to performance in order to develop solutions to improve sleep and ultimately impact performance.

The authors are employed by the Gatorade Sports Science Institute, a division of PepsiCo, Inc. The views expressed in this abstract are those of the authors and do not necessarily reflect the position or policy of PepsiCo, Inc.
Contact
matthew.pahnke@pepsico.com

THE IMPACT OF SLEEP ON COGNITIVE AND SPORT-SPECIFIC PERFORMANCE IN ELITE ATHLETES

KNUFINKE, M.1, NIEUWENHUYS, A.1, MAASE, K.2, MOEN, M.H.2, GEURTS, S.A.E.1, COENEN, A.M.L.3, KOMPIER, M.A.J.1
RADBOUD UNIVERSITY, BEHAVIOURAL SCIENCE INSTITUTE

Introduction
Performance capacity in elite athletes strongly depends on the ability to recover from past exercise[1]. While there is evidence to suggest that athletic performance decreases following (partial) sleep deprivation[2] and may increase following sleep extension[3], it is unclear to which extent natural (day-to-day) variation in sleep impacts cognitive and sport-specific performance.
Methods
To investigate this, objective measures of sleep quantity and sleep stage distributions were assessed among 98 (youth) elite athletes on three non-consecutive nights, and paired with outcomes on performance tests that were taken on standardized times each following morning. Performance tests included a 10-minute psychomotor vigilance task (cognitive performance) and sports-specific tests of fine motor performance (e.g., accuracy) and gross motor performance (e.g., endurance, maximum power). Mixed-effects models were used to assess the effect of sleep quantity (total sleep time, sleep onset latency, wake after sleep onset, sleep efficiency) and sleep stage distributions (REM, light, deep) on performance.
Results
Regarding sleep quantity, longer total sleep times were associated with better cognitive performance (i.e., faster response times; $p = .04$) and shorter sleep onset latencies with better gross motor performance ($p = .03$). Sleep quantity was not associated with fine motor performance. Regarding sleep stage distributions, no significant associations with performance were observed.
Discussion
The current study is the first to combine objective information about day-to-day variation in elite athletes' sleep, with representative indicators of performance. Findings suggest that even minor changes in sleep quantity can significantly affect different aspects of performance (i.e., cognitive performance, gross motor performance), thereby highlighting the significance of a good night rest for elite athletes.
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Contact
m.knufinke@psych.ru.nl

EFFECTS OF SLEEP DEPRIVATION ON CARDIAC AUTONOMIC MODULATION AND ENDURANCE PERFORMANCE IN TRAINED CYCLISTS

ROBERTS, S.S.H., TEO, W.P., WARMINGTON, S.A.
DEAKIN UNIVERSITY

Introduction
It is believed that sleep facilitates recovery from, and adaptation to strenuous exercise [1]. Despite this, athletes often have difficulty sleeping due to the sport-specific demands of training and competition [2]. Therefore, it is surprising that few studies have investigated the effects of sleep on athletic performance. Moreover, the mechanisms through which sleep may influence performance are unknown. The present study aimed to investigate how sleep deprivation affects cardiac autonomic modulation and endurance performance in athletes.
Methods
Thirteen trained cyclists completed two experimental trials that each comprised of two consecutive days of testing (D1, D2). The sleep deprivation trial (SDEP) required participants to undertake a night of sleep deprivation between testing days. The normal sleep trial (NORS) required participants to undertake normal sleep at home. Sleep was monitored for 5-days prior to, and 5-days following, each trial using an activity monitor and sleep diary. Daily mean HR and HR variability were also monitored over the same period. On testing days, a 5-minute Pre-Exercise Recovery Test (PERT) was undertaken to examine HR kinetics at the onset of exercise. This was followed by an endurance time trial (TT) that required a set workload to be completed as quickly as possible. Maximum HR during, and HR recovery (HRR) following the TT were recorded.
Results
TT performance was slower on D2 of SDEP (65.3 ± 2.6 min, mean ± SEM) compared with both D2 of NORS (59.0 ±1.1 min), and D1 of SDEP (58.5 ± 1.1 min) ($P<0.05$). Maximum HR during the TT was lower on D2 of SDEP (162 ± 4 beats.min-1) compared with D2 of NORS (174 ± 3 beats.min-1), and D1 of SDEP (174 ± 3 beats.min-1). Morning resting HR was lower on D2 of SDEP (53 ± 7 beats.min-1) compared with D1 of SDEP (55 ± 8 beats.min-1). Total sleep time was greater on the day/night following sleep deprivation compared with normal sleep ($P<0.05$). HR kinetics and HRR following the time trial were not different between trials, or from D1 to D2.
Discussion
Sleep deprivation impaired endurance performance in cyclists. However, a short light-intensity exercise test (PERT) showed no difference in cardiac autonomic modulation, suggesting that muscle mechanoreflex and central command mechanisms that withdraw parasympathetic activity remain functional following sleep deprivation. Therefore, impaired TT performance following SDEP may be due to either central or peripheral mechanisms that attenuate the sympathetic response to high-intensity exercise.
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Contact

rspen@deakin.edu.au

NIGHT GAMES: PHYSIOLOGICAL, NEUROENDOCRINE AND PSYCHOMETRIC MECHANISMS TO EXPLAIN POOR SLEEP IN ATHLETES

JULIFF, L.E., PEIFFER, J.J., HALSON, S.L.

NETBALL AUSTRALIA

Introduction
Night games are a regular occurrence for team sport athletes, yet sleep complaints following night competitions are common. The mechanisms responsible for reported sleep difficulty in athletes is not understood.
Methods
An observational cross-over design investigating a night netball game and a time matched rest-day in twelve netball athletes was conducted to ascertain differences in physiological (core temperature), psychometric (state and trait) and neuroendocrine (adrenaline, noradrenaline, cortisol) responses.
Results
Following the night-game, athletes experienced reduced sleep durations, lower sleep efficiency, early awakenings and poorer subjective sleep ratings compared with the rest-day. No differences were found between core temperature, state psychometric measures and cortisol at bedtime. Adrenaline and noradrenaline concentrations were elevated compared with the time matched rest-day prior to (26.92±15.88 versus 12.90±5.71 and 232.6±148.1 nmol/L versus 97.83±26.43 nmol/L, respectively) and following the night-game (18.67±13.26; 11.92±5.71 nmol/L and 234.1±137.2; 88.58±54.08 nmol/L, respectively) however did not correlate to the sleep variables (duration, efficiency and sleep onset latency). A correlation (rs=-0.611) between sleep efficiency and hyper-arousal (trait psychometric measure) was found.
Discussion
Athletes' experienced poor sleep following a night-game. Further, results suggest athletes who have a tendency towards a high trait arousal may be more susceptible to sleep complaints following a night-game. This data expands knowledge and refutes frequently hypothesized explanations for poor sleep following night competition. It may also assist support staff and coaches to target strategies for individual athletes at a higher risk of sleep complaints.

Oral presentations

OP-PM33 Fatigue and performance

MULTIPLE TENNIS MATCHES IN ONE DAY: THE EFFECT OF FATIGUE IN JUNIOR TENNIS PLAYERS

DUFFIELD, R.1, MARAGA, N.1, REID, M.2.

1. UNIVERSITY OF TECHNOLOGY SYDNEY. 2. TENNIS AUSTRALIA.

Introduction
Junior tennis tournaments often require players to complete multiple matches in the same day, though the effect on ensuing match performance remains unknown. This study examined the effect of playing multiple matches a day on the physical, physiological and perceptual responses in junior high-performance tennis players.
Methods
Six high-performance junior male tennis players undertook 3 simulated singles matches on the same day for a duration of 90min per match, with a recovery period of 45min between matches (including post-match testing and 30min recovery). Physical capacity (5-0-5 agility, countermovement jump [CMJ], maximal voluntary contraction [MVC] of the shoulder internal [IR] and external rotators [ER]), serve performance (speed and accuracy), creatine kinase (CK) and perceptual (muscle and joint soreness and pain, recovery and fatigue ratings) measures were obtained before match 1 and then immediately following the completion of each match. Heart rate, distances and speeds covered, rating of perceived exertion (RPE), as well as stroke count and the mean stroke acceleration profiles were measured during all three matches. Statistical analysis compared the characteristics of each match and the changes between pre- and all post-match measures. Changes (+ 90% confidence interval [CI]) > 75% likely to exceed the smallest important effect size (0.2) were considered practically important.
Results
Total movement distance (-0.63+0.90, 81% likely) and mean running speed (-0.61+0.82, 82% likely) declined in match 2 compared to match 1, though match 3 returned to match 1 levels. Match 2 also saw a reduction in the total number of strokes played (-11.0+17.7, 84% likely) compared to match 1 and 3. However, the stroke acceleration magnitude did not differ between matches. Serve test accuracy declined post-match 3 (0.76+1.15, 81% likely) compared to pre-match 1, though serve velocity did not change throughout. A decline in shoulder ER MVC (-0.57+0.44, 92% likely) and a reduction in 5-0-5 agility (0.75+0.35, 99% likely) following match 3, though CMJ height and peak power did not change throughout. CK, pain and fatigue ratings and muscle and joint soreness were higher after matches 2 and 3 compared to baseline.
Discussion
Repeated same-day tennis matches leads to impairments in tennis-specific physical capacities, including reduced shoulder function and change of direction speed, alongside increased perceived fatigue and soreness. The between-match fluctuations in stroke count and movement infer altered match-play strategies, due to either pacing or changes in cognitive effort ie. motivation. Regardless, these findings illustrate increased strain and altered match-play characteristics following repeated same-day tennis matches.
Contact
Rob.Duffield@uts.edu.au

THE EFFECT OF SHORT-TERM FATIGUE ON SUBSEQUENT SKILL PERFORMANCE OF ELITE U-19 HONG KONG SOCCER PLAYERS

O'REILLY, J., WONG, H.S.S.

THE CHINESE UNIVERSITY OF HONG KONG

Introduction
Key elements of soccer include the players' ability to perform repeated high-intensity work while maintaining efficient skills when in possession of the ball. Many studies have recently focused on the measurement of skill and the validity of field-based tests (Rampininiet al., 2007) as they relate to soccer performance. Skill performance can become impaired following bouts of brief, high-intensity exercise (McMorris et al., 2007). The aim of this study was to measure the effect of short-term fatigue on subsequent skill performance in elite U-19 Hong Kong international soccer players
Method
16 members of the U-19 Hong Kong national soccer team took part in this study (mean ± SD: age 23 ± 3.2y; height 1.61 ± 0.7m; Body mass 55.2 ± 8.7kg). Following two familiarization trials using the Loughborough Soccer Passing Test (LSPT) (Ali et al., 2008), the exercise protocol consisted of a standardized 10 minute dynamic warm-up, followed by baseline LSPT measurements. Then, each participant completed a standardized soccer-specific repeated sprint ability test[1] (RSA) in order to induce game-specific, short-term fatigue. Upon completion of the RSA, each participant was immediately re-tested on the LSPT. Heart-rate (HR) monitors were used to monitor exercise intensity. Self-perceived measures for exertion (RPE), thirst and gut fullness were recorded throughout the main trial.
Results
No significant differences were observed in any of the movement (mov), penalty (pen) or total (tot) time taken to complete the LSPT between the pre- and post-RSA scores (Mov: pre 48 ± 3s, post 48 ± 4s; Pen: pre 6 ± 8s post 6 ± 8s; Tot: pre 54 ± 9s, post 54 ± 11s, $p > 0.05$). Heart-rate and perceived exertion for pre- (HR: 102 ± 9 bpm; RPE: 9 ±1.1) and post- (HR: 161 ± 12 bm; RPE: 17 ± 1.8) indicated that the RSA test had induced a bout of short-term fatigue.
Discussion
This study highlights an ability of elite level U-19 Hong Kong international soccer players to maintain a consistent level of skill performance, despite a heightened level of physiological stress.
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IMPACT OF MENTAL AND PHYSICAL FATIGUE ON BASKETBALL-SPECIFIC PERFORMANCE

SMITH, M.1,2, CONTE, D.3, DE JONG, L.4, TESSITORE, A.3, FAVERO, T.5 BADIN, O.1, COUTTS, A.J.1

1: UNIVERSITY OF TECHNOLOGY SYDNEY 2: UNIVERSITY OF NEWCASTLE, 3: UNIVERSITY OF ROME "FORO ITALICO", 4: UNIVERSITY OF GRONINGEN, 5: UNIVERSITY OF PORTLAND

Introduction
Basketball competition is highly demanding, exposing athletes to fatigue that may impair physical and technical performance. However, there is a lack of research investigating the impact of fatigue on basketball-specific performance in a controlled environment. Therefore, the purpose of this investigation was to assess the effects of mental and physical fatigue on reactive agility and basketball skill performance.
Methods
Following a randomized, cross-over design, 11 male, recreational basketball players (age 24.9 ± 4.4 y, height 182.6 ± 7.5 cm, body mass 81.0 ± 11.1 kg, playing experience 10.5 ± 5.4 y) performed a reactive agility test (RAT) and a combined basketball skill test (CBST) before and after separate mentally and physically fatiguing protocols. Mental fatigue was induced using a 45-min Stroop task, while physical fatigue was induced using the Yo-Yo Intermittent Recovery Test, level 1. Outcome measures included RAT split-1, split-2 and total time, and CBST performance, completion, and penalty times, total number of errors, rating of perceived exertion (RPE), and percentage of maximal heart rate (%HRmax). Within- and between-treatment changes in CBST and RAT performance were assessed using a magnitude-based approach, to determine the chances of differences being trivial or true.
Results
Mental fatigue impaired RAT total time (likely; ES = 0.35), while physical fatigue very likely impaired all RAT splits (split-1: ES = 0.60; split-2: ES = 0.72; total time: ES = 0.71). Furthermore, all RAT splits were likely higher in the physical compared to the mental fatigue condition (split-1: ES = 0.46; split-2: ES = 0.47; total time: ES = 0.50). Both mental and physical fatigue very likely impaired CBST performance time (mental: ES = 0.55; physical: ES = 0.42). CBST completion time also increased following fatigue (mental: likely, ES = 0.26; physical: most likely, ES = 0.56). Mental fatigue possibly increased CBST penalty time (ES = 0.26), while the effects of physical fatigue were unclear. %HRmax was likely lower following the fatiguing treatments (mental: ES = 0.33; physical: ES = 0.34). Mental fatigue possibly reduced RPE during the CBST (ES = 0.5), while physical fatigue most likely increase RPE during the CBST (ES = 1.59).
Discussion
This study indicates that both mental and physical fatigue impair reactive agility and basketball skill performance. Basketball teams are advised to assess pre-match activities, to ensure players are not fatigued prior to competition. Coaches should also consider implementing strategies that may reduce the fatigue-induced decrement in agility and basketball skill performance.
Contact
Mitch.Smith@newcastle.edu.au

EFFECT OF MUSCLE FATIGUE FOLLOWING RESISTANCE EXERCISE ON POSTURAL CONTROL IN HEALTHY YOUNG ADULTS

TSCHAN, H.1, TRISKA, C.1, LAHMER, A.1, BUERGER, A.1, GRIMM, J.1

1: UNIVERSITY OF VIENNA, INSTITUTE OF SPORT SCIENCE

Introduction

Previous research indicates that acute muscular fatigue can have negative consequences on postural control, which may increase the risk of injury (Papa et al., 2015). However, a better understanding of the underlying mechanisms remains to be investigated. The current study aimed to evaluate alterations in static postural control and the ability to recover from balance perturbations following fatiguing resistance exercise of the lower extremities in healthy young adults through evaluation of center of pressure (CoP) excursions.
Methods
Forty young healthy adults (f=19; m=21; age 24.6±2.2yrs; height 173.0±8.2cm; mass 70.3±12.8kg) performed a bilateral 3x8-repetition velocity-controlled, maximal leg-press exercise protocol (coupled concentric and eccentric exercise) on a motor-driven linear dynamometer (IsoMed2000 linear-module, Germany) with 2 min rest interval between the sets. Force was continuously measured and work capacity calculated allowing to quantify fatigue effects. Computerized posturography (sense wave medical, SENSEPRODUCT GmbH, Austria) was performed pre-exercise and following the fatiguing exercise protocol (after 5 and 45 min of recovery, respectively). Static posturography was performed, recording sway path traveled (CoPT), and sway area covered (RoM) by center of pressure under four bipedal standing conditions that combine two visual situations (eyes open versus eyes closed) with two platform situations (firm and foam supports). Data were analysed using repeated measures ANOVA and significant main effects were followed by Bonferroni post-hoc test.
Results
Lower extremity maximum force output significantly decreased ($p<0.001$) and work was significantly diminished ($p<0.001$) from first to third set of the resistance exercise protocol. Exercise-induced muscle fatigue negatively affected postural control measures in quiet standing 5 minutes after exercise independent of visual situation (CoPT significantly increased $p<0.001$ with eyes open and $p=0.002$ eyes closed, respectively – RoM increased $p=0.018$ eyes open and $p=0.047$ eyes closed). However, no significant fatigue effects could be assessed by standing on a foam surface. Following 45 min. of recovery all sway measures did not differ significantly from pre-exercise values.
Discussion
Current findings indicate that acute muscular fatigue only temporary has negative consequences on postural control and that there is a fast recovery from balance perturbations following fatiguing resistance exercise.
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Contact
harald.tschan@univie.ac.at

DOES MENTAL EXERTION INFLUENCE ROWING PERFORMANCE IN YOUNG ATHLETES?

FILIPAS, L., TAGLIABUE, G., LA TORRE, A., MOTTOLA, F.
UNIVERSITY OF MILAN

Introduction
Mental fatigue refers to the feeling that people may experience after a period of prolonged cognitive activities (Boksem et al., 2008). It has been shown that mental fatigue have a negative effect on endurance performance (Marcora et al., 2009). The effect of mental fatigue in prepubertal children has not been investigated yet. Therefore, the aims of this study were to explore the effect of cognitive demanding task on endurance performance in prepubertal children and to compare the effect of a standard cognitive task (Colour Word Task) with a maths-logic test simulating a school exam.
Methods
Single blind cross-over randomized counterbalanced design. Subjects: eighteen young rower athletes (11-15 years). Each athlete visited the laboratory for 4 trials. Each of the three experimental visits included a cognitive activity followed by a 1500-m time-trial performed on the rower-ergometer. Cognitive activities were Stroop Task (Colour Word Task) and a maths-logic test (60 min), while a leisure activity was used as control condition. Heart rate and perception of effort were measured during time-trial. Alpha was set to <0.05 a priori for differences.
Results
The average time was not significantly different between conditions ($p=0.557$). There was no effect of condition on power output ($p=0.403$). There was not a main effect of condition nor interaction between condition and distance on perception of effort during the time-trial. From NASA-TLX, the Stroop Task and maths-logic test were rated as more mentally ($p<0.000$), temporally ($p=0.001$) demanding and effortful ($p<0.000$) compared to control, while there was not any significant difference between Stroop Task and maths-logic test for any of the NASA -TLX subscales.
Discussion
The main finding of this study was that cognitive demanding tasks did not affect subsequent performance in pre-pubertal children. Previous studies have shown that mental fatigue induced by similar tasks affect endurance performance (Van Cutsem et al., 2017) and this effect was mediated by perception of effort. In contrast, in the present study nor performance nor perception of effort were influenced by the cognitive activities. Similar results were found in élite cyclists (Martin et al., 2015). Authors suggested that élite athletes are more resistant to mental fatigue. Based on the results of the current study, we could speculate that this feature may be present on early stage of athletes development. This is the first study to assess the effect of mental fatigue on rowing performance, therefore further studies are required to compare our results.
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Contact
luca.filipas@unimi.it

Oral presentations

OP-PM68 Cerebral blood flow and oxygenation

CORRELATION BETWEEN CEREBRAL BLOOD FLOW AND BLOOD PRESSURE DURING AND POST EXERCISE IS REPRESENTED IN CENTRAL AUTONOMIC NETWORK; A POSITRON EMISSION TOMOGRAPHY STUDY USING OXYGEN-15-LABELED WATER

HIURA, M.1,2,3, NARIAI, T.2,3, SAKATA, M.3, MUTA, A.2, MAEHARA, T.2, ISHIBASHI, K.3, WAGATSUMA, K.3, TAGO, T.3, TOYOHARA, K.3, ISHII, K.3

HOSEI UNIVERSITY

Introduction
Physical exercise leads to changes in cerebral blood flow (CBF) while cardiac output increases and concomitant changes in autonomic function induce an elevation in blood pressure (BP) (Secher et al., 2008). However, a few studies have used functional imaging with positron emission tomography (PET) to identify the regional CBF (rCBF) response caused by dynamic exercise such as cycling. This study investigated changes in CBF and BP during exercise and post exercise hypotension (PEH).
Methods
Twelve healthy young males performed a 20-min bout of cycling exercise consited of moderate- and high-intensity. Global and regional CBF (gCBF and rCBF) were measured using H215O and PET by the autoradiographic method (Herscovitch et al., 1986) at rest (Rest), at the onset (Ex1) of exercise, later in the exercise (Ex2), and during PEH (Post-Ex). During the procedures, heart rate (HR) and BP were monitored using a transducer system attached to a tube connected to the radial artery catheter. The image data were analyzed using Statistical Parametric Mapping software (SPM 8, Welcome Department, London, UK) and Matlab 7.0 (Math Works, Natick, MA).In addition, quantitative analysis of rCBF was performed using Dr. View software (AJS, Tokyo, Japan).
Results
gCBF increased at Ex1 by 9.6 % from Rest but was unchanged at Ex2, and was significantly decreased by 8.8 % Post-Ex. rCBF was significantly higher at Ex 1 than Rest in the cerebellar vermis, sensorimotor cortex for the bilateral legs (M1Leg and S1Leg), and brainstem, whereas increases in rCBF at Ex 2 were restricted in the vermis and M1Leg and S1Leg. Post-Ex, rCBF was decreased in frontal and parietal cortical regions, hypothalamus and amygdala. Relative decreases ranged from 10.3% to 12.5%. rCBF correlated positively with systolic BP (SBP) in the periaqueductal gray, pons, left precuneus and right cingulated cortex (R2 ranging from 0.17 to 0.37).
Discussion
The robust correlations between SBP and rCBF were identified in broad areas of the "central autonomic network," which includes the insular cortex, amygdala, hypothalamus, peri-aqueductal gray (PAG), parabrachial nucleus in pons, nucleus tractus solitaries (NTS), and rostral ventrolateral medulla (RLVM) as an integrated and integral component of homeostatic regulation (Dampney.1993). These results are compatible with previous neuroimaging studies which investigated central cardiovascular regulation during exercise in brain regions (Critchley et al., 2000). Of note, reflexes or feedback reflex loops that originate from peripheral receptors and project to the NTS and RVLM in the brainstem these regions (Potts, 2006).
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Contact
phmikmd@hosei.ac.jp

REGIONAL DIFFERENCES IN CEREBRAL OXYHEMOGLOBIN CHANGES DURING MODERATE-INTENSITY CYCLING EXERCISE: A NEAR-INFRARED SPECTROSCOPY STUDY

TSUBAKI, A., MORISHITA, S., TAKEHARA, N., TOKUNAGA, Y., SATO, D., TAMAKI, H., ONISHI, H.

NIIGATA UNIVERSITY OF HEALTH AND WELFARE

Introduction
During incremental cycling exercise, cerebral oxyhemoglobin (O2Hb) changes in motor-related areas were measured using near-infrared spectroscopy and were found to differ by region (Tsubaki et al, in press). However, regional differences in O2Hb level within cortical areas during steady load are unknown. The purpose of this study was to investigate brain cortical activity and to evaluate the regional difference during moderate-intensity cycling exercise.
Methods
Twelve healthy volunteers (8 women) participated in this study. After an incremental exercise test on a cycle ergometer to determine the VO2peak, the subjects performed a cycle ergometer exercise on a separate day. After a 3-min pre-exercise rest, exercise was initiated at workloads corresponding to 50% VO2peak for 10 min followed by a 15-min post-exercise rest. O2Hb levels in the prefrontal cortex (PFC), premotor area (PMA), supplemental motor area (SMA), and primary motor cortex (M1) were measured using a 34-channel near-infrared spectrometry system. Skin blood flow (SBF), mean artery pressure (MAP), oxygen consumption adjusted by body weight (VO2/W), and end-tidal carbon dioxide (ETCO2) level were measured synchronously during the experiment. The O2Hb level in each area and other parameters were expressed as changes from the mean pre-exercise rest phase values and calculated every 60 s. One-way analysis of variance was performed to compare these variables according to the factor of time.
Results
O2Hb level increased from 2.42 ± 1.33 to 5.36 ± 4.07 (a.u.) during the 10-min exercise from pre-exercise rest in each area. Significant increases in O2Hb were observed 8 min after starting exercise in the right and left PFC and SMA ($p < .05$), 9 min after in the left PMA ($p < .05$), and 5 min after in the M1 ($p < .05$). SBF increased 7 min after ($p < 0.05$); MAP, VO2/W, and ETCO2 level increased immediately after starting the exercise ($p < .01$).
Discussion

An O2Hb increment was observed in all the areas during the 10-min 50% VO2peak exercise. A significant increase in O2Hb level was also observed, which occurred faster in M1 than in the other areas. The cortical activation pattern based on O2Hb level differed by brain region (Jung et al, 2015). Our results suggest that the activation patterns of M1 differ from those of the other regions during moderate-intensity exercise.
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Contact
tsubaki@nuhw.ac.jp

THE BREATHLESS BRAIN: EEG OSCILLATIONS DURING PROLONGED BREATH-HOLDING IN EXPERT APNEA-DIVERS AND NOVICES

STEINBERG, F., PIXA, N.H., DOPPELMAYR, M.
JOHANNES GUTENBERG-UNIVERSITY MAINZ

Introduction
World records of apnea divers demonstrate that humans are capable of breath-holding over 10 minutes and diving beyond 200 meters deep, both of which involve exceptional psycho-physiological reactions and require training-induced adaptations (Ferretti, 2001). However, little is known about neurophysiological brain responses occurring during prolonged BH. The present approach, therefore, explored electro-cortical (EEG) brain oscillations during sustained BH and investigated whether this unique psycho-physiological state is mirrored in brain hemispherical asymmetry in the alpha band, an electroencephalographic (EEG) index that is associated with emotional processing (Harmon-Jonas et al., 2010).
Methods
Twenty healthy male subjects (30.90 ± 7.24 years) participated in this study. Ten of them were active apnea divers with a capability of more than 5 min static BH (mean 368.8 sec. ± 39.87 sec.) and ten others had no previous experience in BH. EEG (32 channels), heart rate and peripheral oxygen saturation was measured in rest and either during 4 minutes of dry static BH (experts) or 2 minutes (novices) in laboratory conditions. Theta, alpha and beta frequency band amplitudes were computed for one minute segments and alpha asymmetry scores (AAS) were calculated (e.g. amplitude F4 – F3). ANOVAs compared these frequency bands and AAS between and within the groups with respect to the duration of BH.
Results
In expert apnea divers, the alpha amplitude significantly decreased at the end of BH across the whole brain compared to resting activity. In novices on the other hand this was observed only at centro-parietal sites. Compared to the resting state prior to BH, the AAS significantly increased ($p < 0.01$) at the end of expert's BH. This indicates that the left was higher than the right prefrontal cortex activity if considered that AAS conceptualization is based on the assumption that the alpha band is inversely related to regional brain activity. Theta and Beta bands were not different between groups nor were they affected by the time course of BH.
Discussion
The decrease of alpha at the end of the expert's BH is most probably caused by the physiological changes associated with hypoxia and hypercapnia. The frontal AAS increase in expert's points out that sustained BH involves a different processing of the left and the right prefrontal cortex, which might reflect the emotional responses to BH such as inhibiting and controlling the urge to breath.
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Contact
Fabian.steinberg@uni-mainz.de

CEREBRAL OXYGENATION DURING CORTICAL ACTIVATION: THE DIFFERENTIAL INFLUENCE OF THREE EXERCISE TRAINING MODALITIES

COETSEE, C., TERBLANCHE, E.
STELLENBOSCH UNIVERSITY

Introduction
Cross-sectional studies have shown that cortical activation elicits an increased cerebral oxygenation response, characterized by an increase in oxy-haemoglobin (O2Hb) and a decrease in deoxy-haemoglobin (HHb). However, less is known about the effects of exercise training on this cerebral oxygenation response. The purpose of this study was to determine if the cerebral oxygenation response during cortical activation is influenced by the exercise training mode.
Methods
Sixty-seven inactive individuals (55 to 75 years) volunteered for this intervention study. Participants were allocated to a resistance training (RT) group (n=22), high-intensity interval training (HIIT) group (n=13), moderate continuous training (MCT) group (n=13) and a control (CON) group (n=19). Each training group performed three supervised exercise sessions per week for a period of 16 weeks. Near-infrared spectroscopy (NIRS) was used to measure cerebral oxygenation during the Stroop task. A submaximal Bruce treadmill test was used to measure changes in walking endurance. Data were analysed using mixed model repeated measures ANOVA and $P < 0.05$ was considered statistically significant. Cohen's effect sizes were calculated to compare the magnitude of differences in outcome variables between the groups.
Results
The GROUP x TIME interaction for reaction time on the naming and executive Stroop conditions were not significant ($P > 0.05$). At post-test, the CON group showed increased brain activation, with significantly higher relative O2Hb values during the naming Stroop condition compared to pre-test (an increase from 34.8 ± 35.0 to 68.2 ± 52.2 μMol; $P < 0.05$), while their increased O2Hb during the complex condition showed a distinct trend toward significance (an increase from 50.7 ± 38.2 to 79.3 ± 52.7 μMol;$P = 0.09$). MCT and HIIT participants exhibited a reduced amount of brain activation during the Stroop task after the 16-week period (a smaller increase in O2Hb and a smaller decrease in HHb), with MCT participants showing a significant increase in HHb (i.e. a smaller decrease) compared to pre-test

during the naming Stroop condition (from -20.3 ± 15.1 to -9.4 ± 8.7 µMol; P < 0.05) and executive Stroop condition (from -31.1 ± 19.5 to -13.6 ± 8.7 µMol; P < 0.05). The RT group did not show any statistically significant changes in their brain activation patterns during the Stroop conditions when comparing pre- and post-test values (P > 0.05). The HIIT group improved significantly in walking endurance after 16 weeks (from 4.4 ± 1.7 to 5.9 ± 1.5 min;P < 0.05).
Discussion
Sixteen weeks of exercise training resulted in more efficient cerebral oxygenation during cortical activation compared to a no-exercise control group. Furthermore, HIIT and MCT were superior to RT for task-efficient cerebral oxygenation and improved oxygen utilization during cortical activation in older individuals.

EFFECT OF AGE ON CEREBRAL BLOOD FLOW RESPONSES TO INTERVAL AND CONTINUOUS EXERCISE

KLEIN, T.1,2, BAILEY, T.G.1, ABELN, V.2, KERHERVÉ, H.1, SCHNEIDER, S.1,2, ASKEW, C.D.1

1: SCHOOL OF HEALTH AND SPORT SCIENCES, UNIVERSITY OF THE SUNSHINE COAST, MAROOCHYDORE, QLD, AUSTRALIA; 2: INSTITUTE OF MOVEMENT AND NEUROSCIENCES, GERMAN SPORT UNIVERSITY COLOGNE, GERMANY

Introduction
Lifelong exercise improves cerebrovascular function and is protective against the age-related reduction in cerebral blood flow. It is suggested that repeated increases in blood flow, and shear stress, during acute exercise may be the stimulus for the improvements in cerebrovascular function observed with exercise training. The aim of this study was to compare the cerebral blood flow responses between younger and older men during moderate intensity continuous cycling exercise, and to contrast this with work-matched interval exercise.
Methods
Twelve young (Y: 25±3 y) and 12 older (O: 69±2 y) healthy men performed two bouts of moderate-intensity cycling (power output at 70% predicted HRmax) in a random order: 1) interval cycling (INT: 10 x 1min exercise separated by 1min rest); and 2) continuous cycling (CONT: 10min exercise) that were matched for accumulated exercise duration. Middle cerebral artery blood flow velocity (MCAV; transcranial Doppler ultrasound), mean arterial blood pressure (MAP; Finometer), end-tidal CO2 (PETCO2) and heart rate (HR) were measured at rest and throughout each exercise bout. Mean responses over the exercise periods for INT (20min) and CONT (10min) were calculated and are expressed relative (%) to baseline values. Effects of age and mode (INT/CONT) were determined using repeated measures ANOVA.
Results
Baseline MCAV (O:47.9±8.8 Y:66.6±7.5 cm/s, p<0.001) and PETCO2 (O:31.4±3.8 Y:35.2±3.3 mmHg, p<0.05) were lower in the old, and MAP was higher (O:97.8±7.8 Y:83.5±9.6 mmHg, p<0.01) compared with the young. During CONT the average increase in MCAV from baseline was greater in the young (O:16±12 Y:36±19%, p<0.01), whereas MAP (O:29±15 Y:29±10%, p=0.91) and PETCO2 (O:13±9 Y:21±12%, p=0.11) responses were not different between age groups. There were significant mode effects where the average rise in MCAV and MAP were lower during INT compared with CONT (p≤0.03). During INT, the increase in MCAV tended to be higher in the young (O:10±10 Y:22±16% p=0.07). Increases in MAP (O:21±14 Y: 15±14%) and PETCO2 (O:11±11 Y:14±10%) during INT did not differ significantly between age groups.
Discussion
During interval exercise, the responses of MCAV and MAP were attenuated compared with continuous exercise, but were not different between age groups. During continuous exercise, the rise in MCAV was lower in the older men, despite there being no difference in the relative blood pressure response compared with young. This may suggest that impaired responsiveness to changes in blood pressure in older men contributes to lower cerebral blood flow during continuous exercise, but not interval exercise, compared with younger men.
Contact
tklein@usc.edu.au

CEREBRAL BLOOD FLOW RESPONSE TO APNEA IN HUMANS: INFLUENCE OF HYPERVENTILATION

PÉREZ-VALERA, M., CURTELIN, D., MARTIN-RINCON, M., FERNANDEZ-ELIZAGA, A., GELABERT-REBATO, M., MORALES-ALAMO, D., CALBET, J.A.

UNIVERSITY OF LAS PALMAS DE GRAN CANARIA / IUIBS

Introduction
Cerebral vascular conductance is continuously adjusted to maintain cerebral oxygen delivery compensating for changes in both arterial O2 content (CaO2) and blood pressure. When CaO2 and/or blood pressure are reduced, cerebral vascular conductance is increased, and vice versa. During prolonged apnea, CaO2 is reduced while mean arterial pressure and sympathetic activity are increased. However, the cerebral blood flow (CBF) dynamics have not been described. Therefore, the aim of this study was to determine the CBF response to apnea and its regulation following PaCO2 reduction elicited by prior hyperventilation (HPV).
Methods
Ten healthy physically active men (age: 22±2.9 years; mass: 76.5±10.7 kg; height: 178±7 cm,) performed cycles of two voluntary maximal dry apneas (seated position). One apnea (in random order) was preceded by one min of HPV to reduce PETCO2 to values 14-16 mmHg. Apneas were interspaced by 5 min of rest (free breathing) and this cycle repeated 3 times, so all subjects performed 3 apneas with (HPV-Apnea) and without (Free-apnea) HPV. During the apneas, middle-cerebral artery velocity (MCAv) (two Doppler 2MHz transducers applied bilaterally), pre-apnea respiratory variables (breath-by-breath), brain oxygenation (NIRS), and SpO2 (pulse oximetry) were measured.
Results
HPV increased apnea time from 99.7±46 to 121.6±48 s (P<0.01). Compared to the last 10s before apnea, MCAv was reduced by 22% during the free apneas, following a parabolic pattern with nadir values reached after 24.8 s (MCAv in cm/s = 39.4 -0.685xt + 0.0138xt2, r2=0.999), where "t" represents the time elapsed (seconds). This initial drop in MCAv was not observed in the HPV-apneas. HPV reduced MCAv immediately (mean of 10s) before the apnea from 39.4±7.8 to 18.8±5.0 cm/s (P<0.001). From the minimum to the breaking point (apnea end), MCAv increased linearly with similar slopes (0.31±0.09 and 0.30±0.11 cm/s2, P=0.47). However, the intercept of the straight line was 28% lower for the HPV than the free apneas (28.8±5 and 20.5±5 cm/s, P<0.001). From the apnea start to the end, MCAv was increased by 58% during the free apneas and by 3.2-fold in HPV-apneas. At the breaking point MCAv was similar in both conditions. Despite the lower CBF during the HPV-apneas, brain oxygenation was barely altered during the apneas.
Discussion

This study shows that HPV before apnea reduces CBF immediately before the apnea and also during most of apnea time. Despite this reduction in brain O2 delivery, apnea time was enhanced by the preceding HPV, likely due to the reduction of PaCO2, emphasizing its importance as a crucial mechanism determining apnea time in non-divers.

Oral presentations

OP-PM71 Wintersports, athletics, and rowing

CHARACTERISTICS OF HURDLE CONTACT PATTERN AND ITS RELATION WITH RACE PERFORMANCE IN 110M HURDLES

IWASAKI, R.1, SHINKAI, H.2

1GRADUATE SCHOOL OF EDUCATION,TOKYO GAKUGEI UNIVERSITY(TOKYO,JAPAN) 2TOKYO GAKUGEI UNIVERSITY(TOKYO,JAPAN)

Introduction
The record for the 110m hurdles is related to maximum run speed, average and minimum interval time. Moreover, it has been reported that appearance time of peak run speed and its duration differ depending on the performance level of the hurdlers (Shibayama et al. 2010). On the other hand, influence of contact with hurdles for the race time has not been examined. In general, it is considered that hurdle contact gives a negative influence to race record and result, while the hurdlers sometimes gain a win and/or record update. The purpose of this study was to investigate the relationship between the hurdles contact and the performance in 110m hurdle races.
Methods
The hurdle contacts of 326 cases were analyzed from the race movies collected through the internet. All movies were Japanese domestic top races or International races from 2015 to 2016. All contacts with hurdles were classified as follows: (0) no contact, (1) contact-1 (with keeping the posture), (2) fall-1 (with keeping the posture), (3) contact-2 (losing the balance), (4) fall-2 (losing the balance). Appearance ratio of each contact patterns from 1th to 10th hurdle was calculated. In addition, each classification numbers scored, and total points of a hurdler in a race were counted. The difference of appearance ratio among hurdles and the relationships between total points and race performances were analyzed using by X2-test and Pearson's correlation coefficient, respectively ($p<.05$).
Results
In semi-final races, no contact (0) increased, and contact-1 (1) decreased significantly at 4th hurdle. In addition, fall-1 (2) increased significantly at 10th hurdle. On the other hand, no contact (0) decreased, and contact-1 (1) increased significantly at 4th hurdle in final races. No correlation was found between total points of contact and race record ($r = -.04$), while significant low positive correlation was found between total points and race result ($r = .24$) in all rounds. In the case of final races, there was significant low positive correlation between total points and race record ($r = .29$).
Discussion
Some studies had reported that the horizontal velocity between 4th and 5th hurdle is highly correlated with the race results (Iskra, 1995). It can be expected that no contact (0) at 4th hurdle allows for keeping the maximum velocity. Since reaching the final is top priority in semi-final, no contact (0) at 4th hurdle might be increased by cautious hurdling of the runners. Increase of fall-1 (2) at 10th hurdle might be caused by fatigue and/or psychological impatience. Moreover, increase of contact-1 (1) coinciding with decrease of no contact (0) at 4th hurdle was due to the aggressive hurdling in the interval appeared maximum velocity for a win.

ESTIMATING OPTIMAL STRIDE FREQUENCIES IN RUNNING FROM TRAINING DATA

VAN OEVEREN, B.

RESEARCH INSTITUTE MOVE

Introduction
The use of electronic devices in running has become increasingly popular. In the Netherlands, it is estimated that 60-90% of the runners uses electronic devices to support their running. Running is often recommended because of its health benefits, but unfortunately, some of the benefits are counterbalanced by the risk of injuries. It has been shown that increasing stride frequency (SF) reduces impact accelerations. In addition, for a given speed, SF adaptations can minimise metabolic demands. SF, speed (V) and heart rate (HR) are commonly measured by sports watches and smartphone applications. Running at optimal SF probably involves a combined minimization of energy costs and impact forces and can be achieved when relations between SF, V and HR are known. The current study aimed to derive these relations from training data obtained under free running conditions. However, reliable modelling can only be done after careful selection of observations. We developed a method to select and derive optimal SF from unsupervised collected training data.
Methods
Training data were collected by recruitment of subjects using social media. Participants filled out an online questionnaire and additionally shared data from their sports watches. For practical considerations, only data from Garmin sports watches were included in the analysis. This resulted in useful data from 243 participants. To be able to model the data, filtering was crucial. The filtering was done using the following automated steps: (i) selecting running activities; (ii) selecting stable observations (constant HR and speed) within each time series; (iii) removing outliers per subject using a Kernel density procedure. The optimal SF was calculated using a 95% confidence ellipse on the HR-SF distribution. This procedure was repeated for every 0.13 m·s-1 speed increase, with a bin size of 0.28 m·s-1. The resultant optima and the habitual SF of runners were modelled using general estimating equations, with subject as a random effect variable, SF as dependent variable and V and V2 as independent variables.
Results
0.88% of the data was defined as outlier, the remaining 1700 hours of running data were used for the modelling procedure. For the group of participants, the relation between V and SF was best described by $SF = 5.293 \cdot V - 0.184 \cdot V2 + 69.650$. The optimum curve was somewhat lower with $SFopt = 6.221 \cdot V - 0.325 \cdot V2 + 67.809$, but this difference was not significant. As an example, with V = 3.33 m·s-1 (12 km·h-1), this gives 85.25 strides·min-1and an SFopt at 84.93 strides·min-1.
Discussion
This was the first study that used commercial running equipment to study the relation between SF and V in several hundreds of subjects under free running conditions. We were able to estimate optimal SF at different speeds based on observed minimal HR from the data. Optimal SFs were slightly lower than the SFs usually selected by the participants but this difference was not significant.

START PERFORMANCE IN SKI- AND SNOWBOARD CROSS: IMPORTANCE AND OPTIMIZATION IN COMPETITIVE SPORT

OLVERMANN, M., FRÜHSCHÜTZ, H., GOLL, M., HUBER, A., SPITZENPFEIL, P.

TECHNICAL UNIVERSITY MUNICH

Introduction

Ski cross and Snowboard cross are developing disciplines in winter sports and part of the Olympic Games since 2010. Few research articles have been published and knowledge is mainly based on the experience of coaches and athletes. However, the performance at the start and in the following section seems to be crucial for overall performance (Argüelles et al., 2011). Therefore, the purpose of this study was to investigate the kinetics and kinematics of different starting movements in both disciplines and to identify the relevant parameters for an effective start.

Methods

21 competitive athletes, 14 male and 7 female, of the German National Ski and Snowboard Team participated in this study. The athletes performed several starts in a steep and a flat starting area. The test was performed in a ski hall on artificial snow with a world-cup approved start gate. The starts were preset with four different motion specifications, the athletes performed in randomized order. A 10-camera motion capture system (Simi Reality Motion Systems GmbH, Munich, Germany) was used to measure the kinematic data with a sampling rate of 100 Hz. Kinetic data were recorded with special handles (HJM Messtechnik GmbH, Kastl, Germany) with a sampling rate of 1000Hz. Integrated two axial force transducers measured the forces from the pre-start phase to release. Additionally, a time measurement was made with light barriers for evaluating the starts based on the starting time.

Results

For the Ski Cross athletes, the maximum peak forces, related to bodyweight, was in average 12,47 ± 2,2 N/kg. This value correlates strongly to the starting time with a coefficient of r=.91. For all different starting techniques, the pre-start force was in average 364 ±116 N. In the pre-start phase the height of the center of mass has a mean value of 0,83 ±0,08m in absolute terms, related to the body size 0,52 ±0,08. The Snowboard Cross Athletes have similar values. The occurring differences can be attributed to the different material in the two sports and the asymmetric position in the starting phase.

Discussion

The measurements were accomplished in a realistic starting area with constant snow and air temperature. As expected, the start is more effective, if the athlete generates a higher force value during the pull phase. A good force transmission depends on body position and acceleration distance. These results are suitable for recommendation for coaches and athletes.

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Contact

matthias.olvermann@tum.de

LABORATORY-BASED FACTORS PREDICTING PERFORMANCE IN BIATHLON SKIING

LAAKSONEN, M., ANDERSSON, E., JONSSON, M., MCGAWLEY, K.

MID SWEDEN UNIVERSITY

Introduction

Maximal oxygen uptake (VO2max), VO2 at lactate threshold (VO2-LT), and gross efficiency (GE) are the three main factors determining endurance performance (1) and while the skiing component of biathlon is of an enduring nature, involving 3 or 5 bouts each lasting 5-8 min (2), the contribution of these factors to skiing performance in biathlon has not previously been investigated. Thus, the purpose of this study was to evaluate the association between laboratory-based measures and skiing performance in biathlon.

Methods

Twenty-eight Swedish biathletes competing both at national and international levels (14 females, 23+/-3 yr, VO2max 56+/-4 mL/kg/min; 14 males 24+/-4 yrs, VO2max 66+/-3 mL/kg/min) performed a submaximal incremental test followed by a maximal time-trial (TT) prior to the start of the 2016-17 season. Treadmill roller-skiing was used for testing and VO2max, VO2-LT (4 mmol/L), GE, as well as aerobic (AeMR) and anaerobic (AnMR) metabolic rates, were calculated (3). All participants competed in a same biathlon competition (BC) within two months of testing, which formed the basis for 2016-17 international team selection. Skiing time during both TT and BC (without time spent shooting) were subsequently correlated to the laboratory measures.

Results

TT and BC times were significantly correlated in both sexes (females $r=0.67$, $p<0.01$; males $r=0.71$, $p<0.01$). VO2max was related to TT ($r=-0.72$, $p<0.01$) and BC ($r=-0.54$, $p<0.05$) times for the females but not the males (TT $r=-0.45$, $p=0.10$; BC $r=-0.46$, $p=0.10$), while VO2-LT was not associated to TT or BC times. GE was correlated with BC time in both sexes (females $r=-0.54$, $p<0.05$; males $r=-0.56$, $p<0.05$) but with TT time only for the males (females $r=-0.38$, $p=0.18$; males $r=-0.62$, $p<0.05$). AeMR was correlated with TT time in the females ($r=-0.75$, $p<0.01$; males $r=-0.44$, $p=0.11$), while AnMR was not related to TT or BC times for either sex. A block-wise multiple regression analysis employing TT time as the dependent variable and GE, AeMR and AnMR as the independent variables resulted in significant r2 values for both females ($r2=0.92$, $p<0.001$) and males ($r2=0.94$, $p<0.001$). When BC time was used as the dependent variable and VO2-LT and accumulated O2 deficit as the independent variables, r2 was not significant for either sex (females $r2=0.29$, $p=0.16$; males $r2=0.36$, $p=0.09$).

Discussion

The present results indicate that laboratory-based TT performance is associated with real-world skiing performance in biathlon. In addition, GE seems to be a more important factor for skiing performance than VO2-LT, whereas VO2max seems to be more important for females than males, indicating potential sex differences in our study population.

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TEAM SYNERGIES IN ROWING: HOW RECIPROCAL COMPENSATION CHANGED UNDER THE EFFECT OF VARYING CADENCES

RKIOUAK, M., GORMAN, J.C., SAURY, J., BOURBOUSSON, J.

UNIVERSITY OF NANTES

Introduction

While team synergies are a topic for understanding the emergence of collective behaviors in sport (Araujo & Davids, 2016), no study has investigated the reciprocal compensation process between team members that allow them to move as a whole in a naturalistic joint action task. The purpose of the present study was to characterize the reciprocal compensation process in rowing and the impact of rowing rate on this process.

Method

The behaviors of an expert female coxless-pair crew were tracked regarding different cadence conditions: 18 cadence (C1), 24 cadence (C2), 28 cadence (C3) and 36 cadence (C4). Behavioral measures were collected with the Powerline system. The uncontrolled manifold was applied to the phase angle of both rowers during the drive phase in each condition to track the ratio RV (i.e, VarUCM/VarORT), an indicator of reciprocal compensation (Latash, et al., 2002). Entry, drive-body, and release sections of the drive phase were delineated. Hierarchical clustering was used to show the similarities/dissimilarities between the periods of each condition. Verbalization data (R'Kiouak et al., 2016) was analyzed to examine what participants perceived and how they regulated their interpersonal states within each condition of pace. Verbalization data was processed using a qualitative thematic analysis (Braun & Clark, 2006).

Results

The results showed that i) the entry was similarly patterned within high cadences (cluster 1= C1; cluster 2= C2, C3 and C4), ii) the drive-body patterns differed between low and high cadences (cluster 1= C1 and C2; cluster 2= C3 and C4), and iii) the release was similarly patterned within lower cadences (cluster 1= C1, C2 and C3; cluster 2= C4). The verbal data indicated that the lived experience of the rowers was more salient and detailed about the entry and release sections. Taken together, the results suggest that i) rowers perceived more feedback and were more involved in regulating joint action in lower cadences, and ii) rowers' activity was directed towards regulation of interpersonal states while perceiving intra-individual and boat-related traces of their collective behavior in higher cadences.

Discussion

The results highlight the emergence of a mechanical coupling correlated with the increase of cadence. The results also show that a low cadence allows rowers to produce more reciprocal compensation, involving a complex subjective co-regulation of their joint action. The release appears as a section of the drive that calls for specific attention of coaches to improve rowers' synchronization. These results will be discussed in the context of extra-personal coordination and stigmergic processes.

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THE INFLUENCE OF MATURITY STATUS AND RELATIVE AGE ON TRAUMATIC AND OVERUSE INJURIES AND ILLNESSES IN ELITE YOUTH ALPINE SKI RACERS – A TWO-SEASON PROSPECTIVE STUDY

MÜLLER, L.1, HILDEBRANDT, C.1, MÜLLER, E.2, RASCHNER, C.1

1 UNIVERSITY OF INNSBRUCK, 2 UNIVERSITY OF SALZBURG

Introduction

Alpine ski racing is a sport with a high risk of injury. The main emphasis of injury prevention was placed on top level athletes and traumatic injuries (TI); monitoring TI and overuse injuries (OI) at the youth level remains a lack in scientific research (Spörri et al., 2016). Additionally, the influence of maturity status (MS) and relative age (RA) on injury and illness (IL) rates should be examined. Therefore, the aim of the present study was to assess prospectively the incidence, prevalence and severity of TI, OI and IL and the influence of BM and RA among youth ski racers (YSR).

Methods

A prospective longitudinal cohort design was used. 82 Austrian elite YSR (51 males, 31 females; 9-14 years) were involved in the study. An internet-based database was developed to record training characteristics, TI, OI and IL over two school years. The MS was assessed using the age at peak height velocity method (Mirwald et al., 2002). The birth months were split into four relative age quarters. Frequencies were calculated; chi²-tests were used for comparisons concerning categorical variables.

Results

2020 training sessions (992 skiing, 1098 athletic) with a total mean exposure time of 738 hours were analyzed. 266 medical problems were reported: 52 TI (0.86 TI/1000 h of training), 17 OI (0.28 OI/1000 h) and 197 IL (2.4 IL/athlete). 8 YSR did not report any medical problem. Most of the TI (44.2%) and OI (57.1%) were moderate, affected the bones (TI: 46.1%) or comprised the muscle and tendon structure (OI: 82.3%) and the most frequent injured body part was the knee (TI: 36.5%; OI: 82.3%). Most of the illnesses were minimal (61.9%) and respiratory tract infections (66.4%). No significant differences were found between differing MS groups and RA quarters; however, EM and relatively younger athletes had lower rates of TI and OI.

Discussion

This was the first prospective study with regard to TI, OI and IL involving YSR younger than 15 years. Relatively low incidences of TI and OI were reported compared to the World Cup level and in contrast to the World Cup level, no gender-specific differences were found (Spörri et al., 2016). Though not significant, relatively younger and EM athletes had descriptively lower rates of OI and TI. Thus, RA disadvantages can be counteracted by an advanced MS. In the future, the MS should be considered to prevent late maturing athletes from injuries. Additionally, the injury causes and mechanisms at the youth level should be investigated.

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Contact

Lisa.Mueller@uibk.ac.at

09:45 - 11:15

Oral presentations

OP-PM54 Physiology of high-intensity exercise and training

THE ACUTE RESPONSE TO EXERCISE IN ENDOTHELIAL FUNCTION IS BLUNTED AFTER AEROBIC INTERVAL EXERCISE BUT NOT AFTER MODERATE INTENSITY EXERCISE TRAINING

LYALL, G.K., FERGUSON, C., PORTER, K.E., BIRCH, K.M.

UNIVERSITY OF LEEDS

Introduction
Deteriorating vascular function is an additional contributor to traditional cardiovascular disease risk and can be observed by endothelial dysfunction. Exercise training modifies endothelial function with aerobic interval exercise (AIE) showing mixed outcomes when compared to moderate continuous (CON) exercise. Adaptations in endothelial function are driven by blood flow induced shear rate (SR), the pattern and magnitude of which may differ between AIE and CON. The aim of this study was to evaluate SR during AIE and CON and the subsequent acute impact of this upon pre and post training endothelial function.
Methods
Seven males and 9 females (age: 34±14 years) were recruited to 4 weeks of exercise training twice per week. Participants were randomly assigned to either AIE (4x4min at 85-90% HRpeak with 4min active recovery at 60-65% HRpeak) or 32min CON (65-70% HRpeak) groups. VO2peak, BMI, blood pressure (BP) and endothelial function via brachial flow mediated dilation (FMD) were assessed pre and post exercise training. Doppler ultrasound was used to characterise anterograde and retrograde SR during an individual exercise session pre and post training. The acute exercise effect upon FMD was also assessed 15min post exercise prior to and following training. Data were assessed for group and time effects.
Results
VO2peak increased following training (pre to post: 31.8±9.2 to 34.8±9.3ml/kg/min; P=0.001) with no difference between groups. BMI and BP were unchanged. Pre-exercise FMD increased equivalently in both groups following training (pre to post: AIE 4.7±3.6 to 9.6±4.8%; CON 4.8±3.3 to 7.4±3.2%; P=0.001) with no change in baseline diameter. During a session of AIE or CON patterns of anterograde and retrograde SR differed, however total SR and time in oscillatory shear (32±43 s) did not differ between groups or following training (P>0.05). The magnitude of the acute endothelial response to exercise prior to training was greater following AIE than CON (AIE +8.5±6.0, CON +3.6±3.0%; P=0.04). Following training this acute response in FMD was preserved after CON but was blunted after AIE (CON +2.6±4.5, AIE +0.3±4.9%; P=0.08).
Discussion
Whilst CON exercise produced a constant SR, the recovery periods in AIE created variable SR leading to an equivalent total stimulus for both groups. The greater pre training acute response in endothelial function to AIE thus appears to be driven by the greater magnitude of SR achieved in active bouts. The chronic effect of repeated increases in SR with training on endothelial function was evident in both groups likely as a result of enhanced nitric oxide bioavailability. Following training it appears that the AIE induced SR stimulus is no longer sufficient to acutely elevate endothelial function.

THE ENERGETIC COST OF RUNNING ON A NON-MOTORIZED TREADMILL – PRELIMINARY FINDINGS

SCHOENMAKERS, P.P.J.M., REED, K.E.

UNIVERSITY OF ESSEX

Introduction
Recently, it has been argued that athletes 'in real life' measure and pace their work in high intensity interval training (HIIT) on ratings of perceived effort and accumulated fatigue (Seiler et al. 2013). This is in sharp contrast to the most often used approach in laboratory based experiments, in which responses to predefined fixed work and recovery intervals are studied. A non-motorised treadmill may be more ecologically-valid and therewith more appropriate to study self paced HIIT in a laboratory setting, as a runner can dictate his/her running velocity with every stride on the treadmill belt (Stevens et al. 2015). The aim of this study was to determine how the energy cost of running on a non-motorised treadmill (NMT) compared to running on a regular treadmill (RT).
Methods
Six trained male runners (mean ± SD; age: 33 ± 11 years; VO2max: 58.6 ± 3.2 ml/kg/min; MTV: 5.0 ± 0.2 m/s) performed an incremental running test on a regular treadmill to determine VO2max and the accompanying maximum treadmill velocity (MTV). After a familiarization session on the NMT, subjects ran for 4-min at five different velocities (40 - 80%MTV) with 3-min passive recovery, repeated on a NMT and RT in two separate visits in a randomized order. Respiratory variables, heart rate, stride characteristics, and ratings of perceived exertion were monitored during all visits.
Results
None of the subjects were able to complete the 4-min run at 80%MTV on the NMT. The energetic cost (expressed as %VO2max) of running on the NMT showed to be significantly higher for all other velocities (40%MTV: 66.0 ± 5 vs 53.1 ± 3; 50%MTV: 79.7 ± 6 vs 59.2 ± 5; 60%MTV: 90.5 ± 4 vs 68.8 ± 6, 70%MTV: 97.5 ± 7 vs 79.3 ± 6; $p<0.005$). The higher energetic costs were accompanied by higher exercise heart rates ($p<0.001$) and ratings of perceived exertion ($p<0.005$) for all velocities on the NMT. However, running cadence was only significantly higher for the NMT on 70%MTS (174 ± 15 vs 167 ± 13 steps per minute; $p<0.05$).
Discussion
To study HIIT in a laboratory setting, non-motorized treadmills can be valuable testing equipment, however, interpretation of test data comes with its challenges. In the current experiment, an exercise intensity of 90.5 ± 4 %VO2max was achieved at 60%MTV on the NMT. This intensity is often used as the lower limit of the high intensity exercise domain (Bucheit & Laursen 2013). By extrapolating the current data, the same intensity is estimated to be reached at 82%MTV on the RT, but results need to be verified in future research.
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Contact
ppscho@essex.ac.uk

THE INFLUENCE OF A SIX-MONTH, HIGH-INTENSITY INTERVAL TRAINING INTERVENTION ON THE PULMONARY OXYGEN UPTAKE KINETICS IN ADOLESCENTS WITH AND WITHOUT ASTHMA

WINN, C.O.N.1,2, MACKINTOSH, K.A.2, EDDOLLS, W.T.B.2, WADE, N.D.2, STRATTON, G.2, WILSON, A.M.3, DAVIES, G.A.1, MCNARRY, M.A.2

1: SWANSEA UNIVERSITY MEDICAL SCHOOL, 2: APPLIED SPORTS TECHNOLOGY EXERCISE AND MEDICINE RESEARCH CENTRE, SWANSEA UNIVERSITY, 3: NORWICH MEDICAL SCHOOL, UNIVERSITY OF EAST ANGLIA.

Introduction
Asthma is associated with negative effects on fitness but this has only been considered using peak oxygen uptake (VO2). VO2 kinetics are far more sensitive but there is a lack of research regarding whether the negative effect of asthma is manifest in the dynamic VO2 response and, if so, whether this can be ameliorated through an exercise intervention. Therefore the objective was to determine the influence of asthma on the dynamic VO2 response in adolescents and to investigate the influence of a six-month, high-intensity interval training (HIIT) intervention on this response.
Methods
Fifteen adolescents (13.5±0.8 years; 7 boys; 7 asthma), who participated in a 30-minute HIIT intervention three times per week for six months, were compared to 15 age- and sex-matched controls (7 asthma). Each participant completed an incremental ramp test to volitional exhaustion and three heavy intensity constant work-rate tests to determine the dynamic oxygen uptake response at baseline, 3-months, post-intervention and 3-months follow-up.
Results
At baseline, there was no significant difference in aerobic fitness between those with and without asthma, although there was a trend for a lower peak VO2 in those with asthma. Paired sample t-tests revealed the intervention was associated with a significant increase in peak VO2 in both those with asthma (34.0±7.0 cf. 38.2±4.5 ml·min−1kg-1; t(6)=-3.34, p=0.02, d=1.25) and without (38.0±6.7 cf.41.4±7.1 ml·min−1kg-1; t(7)=-2.71, p=0.03, d=0.95), which was ameliorated at follow up. The intervention was also associated with a significantly greater phase II amplitude at post-intervention in those with asthma (0.84±0.25 cf. 1.11±0.38 l·min−1; t(6)=-4.00, p=0.01, d=1.51) and without (0.93±0.76 cf. 1.16±0.09 l·min−1; t(7)=-4.36, p<0.01, d=1.55). There were no significant differences at any time point in the control group.
Discussion
The present findings therefore suggest that a six month HIIT programme may be effective at increasing the aerobic fitness of adolescents, irrespective of asthma status. The findings also support the notion that the peak VO2 and dynamic VO2 response are dissociated in youth. The lack of difference between those with and without asthma indicates that the negative effects on fitness associated with asthma may not be as profound as previously thought.

CONSIDERATIONS FOR THE DOSE RESPONSE IN SPRINT INTERVAL TRAINING INTERVENTIONS

OCONNOR, D., COBLEY, J.N., BABRAJ, J.A., MALONE, J.K.

UNIVERSITY COLLEGE DUBLIN

Introduction
Lack of time is cited as a common barrier to exercise participation (Gibala et al. 2012). High intensity protocols (e.g. HIIT/SIT) have emerged as effective, time-efficient alternatives to moderate intensity continuous training (Metcalfe et al. 2012). Similar benefits to aerobic capacity and body composition using low vs. high volume sessions of SIT bouts (20s) have been found after 8 wks (Logan et al., 2016). However, the dose response of much shorter SIT bouts (< 10s), which may be better tolerated, is unknown, as are the residual effects once the training stimulus is removed.
Methods
Thirteen healthy sedentary males were matched for VO2peak and assigned to either a low dose (LDG: n = 7) or a high dose (HDG: n = 6) supervised 6-wk concurrent SIT intervention (2/wk of SIT (LDG = 2 sets of 5 x 6s ON: 18s OFF bouts; HDG = 4 - 6 sets of 5 x 6s:18s bouts) and x1/wk resistance training (3 exercises @ 3x10 reps), which began immediately following a 6-wk control period (BL 1&2). Participants were tested at BL 1&2, 48-72 h post intervention (0Post) and 3 wk post (3Post) for physiological and psychological indices of health.
Results
VO2peak increased significantly in both groups (LDG: 32.3 ± 7.6 to 37.6 ± 10.0 ml.kg.-1.min-1; +16%; HDG: 34.4 ± 3.1 to 38.1 ± 3.8 ml.kg.-1.min-1; +11%) compared to BL 2 (P<0.001), with no sig diff between groups (P=0.381). At 3Post, VO2peak decreased sig by 11% in the LDG (37.6 ± 10.0 to 33.4 ± 9.4 ml.kg.-1.min-1; P= 0.033), but increased by 3% in the HDG (38.1 ± 3.8 to 39.2 ± 4.2 ml.kg.-1.min-1; P=0.195) compared to Post, with a sig diff between groups (P=0.002). PE and RPE increased and decreased sig for both groups at post (P=0.035; P<0.001 respectively), with no sig diff between groups at any time point. Blood pressure (SBP, DBP), blood lipids (TC, HDL, TG) or body composition (BM, %BF, muscle mass) indices were not sig diff between groups at any time point.
Discussion
Both LDG and HDG significantly improved VO2peak following a 6 wk concurrent SIT intervention, suggesting the LDG was as effective as the HDG despite a considerably reduced volume. However, VO2peak had largely regressed to BL 2 by 3Post in the LDG group but actually increased by 3% in the HDG group. This suggests that a temporary suppression due to cumulative fatigue may have masked the true benefits of HDG at 0Post. This has important ramifications for the design and interpretation of SIT studies, especially in non-athletic populations.
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Contact
dominic.oconnor@ucdconnect.ie

EXERCISE TRAINING IMPROVES DEPOT SPECIFIC ADIPOSE TISSUE METABOLISM REGARDLESS OF BASELINE GLUCOSE TOLERANCE AND SEX

MOTIANI, P., HONKALA, S.M., MOTIANI, K.K., ESKELINEN, J.J., VIRTANEN, K.A., LÖYTTYNIEMI, E., NUUTILA, P., KALLIOKOSKI, K.K., HANNUKAINEN, J.C.

UNIVERSITY OF TURKU / TURKU PET CENTER

Introduction
Effects of exercise training on muscle metabolism are well characterized whereas the adipose tissue (AT) responses on training are poorly understood. We aim to study the effects of high-intensity interval (HIIT) and moderate intensity continuous training (MICT) on AT substrate metabolism and tested whether the AT responses are similar regardless of baseline glucose tolerance and sex.
Methods
We randomized totally 54 sedentary subjects of whom 26 had defective glucose tolerance (DGT) (8 with impaired glucose tolerance (IGT)/impaired fasting glucose (IFG) and 18 with type 2 diabetes (T2D); BMI 30.1 (SD 2.5); age 49 (SD 4)) and 28 were healthy (BMI 26.1 (SD 2.4); age 48 (SD 5)) into HIIT and MICT for two weeks. AT masses were quantified by magnetic resonance imaging (MRI). Glucose uptake (GU) during euglycemic hyperinsulinemia [1] and fasting free fatty acid uptake (FFAU) in visceral (VAT), abdominal (ASAT) and femoral (FSAT) subcutaneous AT with positron emission tomography (PET) [2].
Results
At baseline, compared to healthy men, DGT men were insulin resistant, had higher body adiposity and lower insulin-stimulated GU in all AT depots and FFAU in VAT and ASAT. Considering the sex, women had 59% lower VAT and 50% higher ASAT mass, higher GU in VAT and FFAU in VAT and FSAT than DGT men. Training increased whole body insulin sensitivity and GU in VAT and FSAT and decreased FFAU in VAT and ASAT ($p<0.05$, all) irrespective of baseline glucose tolerance and sex. HIIT was superior in increasing aerobic capacity (VO2max) and GU in VAT in DGT group whereas MICT reduced FFAU in VAT more than HIIT in both healthy and DGT groups.
Discussion
Although females have higher body adiposity they have less VAT mass and higher AT substrate uptake rate compared to males. Short-term training improves AT metabolism similarly in healthy and DGT subjects and independently of the sex. This study suggests that HIIT is more effective in improving aerobic capacity and VAT insulin sensitivity in subjects with DGT whereas MICT is preferable for VAT lipid metabolism.
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Oral presentations

OP-PM50 Proteins and carbohydrates

SELF-REPORTED CARBOHYDRATE DURING EXERCISE ASSESSED BY A STANDARDIZED QUESTIONNAIRE IS HIGHER THAN THE OBSERVED CARBOHYDRATE INTAKE.

WARDENAAR, F.C.1, VAN DER BURG, N.1, VAN DIJK, J.W.1, VAN LOON, L.J.C.2, DE VRIES, J.H.M.3

1. HAN UNIVERSITY OF APPLIED SCIENCES; 2. MAASTRICHT UNIVERSITY; 3. WAGENINGEN UNIVERSITY

Introduction
To optimize carbohydrate (CHO) intake during exercise, accurate individual dietary assessment is needed. Given the lack of biomarkers for absolute CHO intake, questionnaires are generally used to gain insight in the food intake of athletes during sport events. We compared CHO intake during a cross-duathlon in recreative athletes assessed by a standardized post-exercise food frequency questionnaire with standardized food items (FFEQ) against well-controlled observations of food intake.
Methods
Food intake of 31 trained athletes (24 men and 7 women) during a cross-duathlon (7.0 km running, 20.0 km mountainbiking and 3.5 km running) was assessed by a previously used questionnaire (FFEQ) along with real-time observations. As part of the observation, the athletes' foods and drinks were labeled and weighed, and photographs were taken from all available ingredient declarations. During the race, empty bottles and food wraps were dropped by the athletes, and collected and weighed by the research team. Subsequently, products were weighed to determine the consumed amount. After the race, athletes reported the foods ingested during the race by filling out the FFEQ consisting of 15 frequently used food items during exercise. Mean CHO intake (g.h-1±SD) was calculated using a food composition table (NEVO) or ingredient declarations, and the difference in CHO intake between both methods was analyzed using Wilcoxon-signed-rank-test with statistical significance set at $p<0.05$. The relationship between methods was investigated using Spearman's correlation coefficient with 95% CI. The level of agreement between methods on individual level was assessed by Bland-Altman analysis.
Results
The race was completed in 127±27 minutes. Mainly (isotonic) sports drinks and gels were used during the race. Mean CHO intake assessed by the FFEQ (34.3±27.5 g.h-1) was 9.8±16.9 g.h-1 higher than the observed CHO intake (24.5±19.6 g.h-1; $p=0.004$). There was a good correlation between both methods ($r=.79$; 95% CI: 0.61-0.89). The Bland-Altmanplot, presenting the average CHO intakes of the two methods against the difference of the two methods, showed 95% limits of agreement of -26.5 and 47.2 g.h-1.
Conclusion
Self-reported CHO intake during exercise as determined by a standardized post-exercise food frequency questionnaire can be substantially higher than the amount of carbohydrates that is actually consumed. This finding suggests that self-reported food intake during exercise should be interpreted with caution.

THE EFFECT OF CARBOHYDRATE MOUTH RINSE ON INTERMITTENT SPRINT PERFORMANCE IN SOCCER PLAYERS

KARAYIGIT, R.1, KARABIYIK, H.1, YASLI, B.C.1, KOZ, M.1, ERSOZ, G.1

1: ANKARA UNIVERSITY SPORT SCIENCE FACULTY

Introduction
Carbohydrate (CARB) intake and CARB mouth rinse's ergogenic effect on endurance performance are well documented. Recently, rinsing of CARB in the oral cavity has been proposed as a strategy to increase high intensity exercise performance. Mechanisms of CARB mouth rinsing have been attributed to receptors in the oral cavity that detect the presence of CARB and send signals to the brain, possibly stimulating reward or pleasure centers, which in turn enhance exercise performance (Chambers 2009). In the literature, research is scarce investigating effect of CARB mouth rinse on intermittent sprint performance. The aim of this study was to investigate effect of CARB mouth rinse on sprint performance in soccer players.
Methods
Fifteen male soccer players took part in this study. Following familiarization, in a randomized, crossover, counterbalanced research design, subjects were submitted to three experimental conditions:Control (CON), CARB mouth rinsing (CHO), placebo (PLA). Following 10 hour overnight fasting, subjects performed 12x4 seconds intermittent sprint protocol with 90 seconds active recovery (60 watt) between sprints on a cycle ergometer (Monark 894E, Sweden). Before each sprint, subjects rinsed the solution (%6.4 w/v CARB) 10 seconds durations. Heart rate (HR), blood lactate (LAC), blood glucose (GLU) and rating of perceived exertion (RPE) was measured at resting state, immediately after test and at active and passive recovery periods. Performance and physiological parameters analyzed by repated measures two-way ANOVA.
Results
No significant differences were found for peak ($p>0.825$) and mean power ($p>0.706$), LAC ($p>0.489$), HR ($p>0.830$), RPE($p>0.091$) and GLU ($p>0.151$) between sessions at any time points.
Discussion
This study demonstrated that CARB mouth rinsing doesn't effect on amateur soccer players' sprint power output and other physiological parameters. This study's results are similiar with others. Furthermore, we observed that subject's felt nausea while rinsing of the CARB solutions, further researches should measure feeling of nause.
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Contact
racikarayigit@hotmail.com

EFFECTS OF CARBOHYDRATE INGESTION ON MAXIMAL SPRINT PERFORMANCE AND NEUROHORMONAL RESPONSES

FAM, K.D., ARJUNAN, S.P., CHONG, E.

SINGAPORE SPORTS INSTITUTE

Introduction
Chong and colleagues (2014) found a 9-16% improvement in peak power output with the combined glucose ingestion and mouth rinsing compared to water, aspartame and maltodextrin solutions. The authors suggested that the observed ergogenic effect may be due to non-metabolic central effect via the stimulation of glucose sensing cells in the gastrointestinal tract, including the oral cavity. However, it remains to be determined whether carbohydrate ingestion alone would be sufficient to improve sprint performance. For this reason, the primary aim of this study was to investigate whether carbohydrate ingestion itself can improve the performance of a maximal sprint.
Methods
Twelve active males each ingested 100 mL of one of the following solutions on separate occasions and followed a randomised, double-blinded, counterbalanced design; (a) 10% glucose (w/v), (b) 10.4% maltodextrin (w/v), (c) 0.05% aspartame (w/v), and (d) water as a control. Each participant then performed a 45-s maximal sprint effort on a cycle ergometer and performance was assessed.
Results
Differences between aspartame, maltodextrin and water trials were unclear across all indicators of sprint performance (peak and mean power outputs). In contrast, the glucose trial improved the mean power output over the 45-s sprint effort by 4.7% (ES = 0.40; ±0.27) compared to water trial and by 2.3 (ES = 0.20; ±0.21) and 2.8% (ES = 0.23; ±0.14) compared to the aspartame and maltodextrin trials, respectively. Blood glucose and insulin levels increased to a similar extent in response to the maltodextrin and glucose trials.
Discussion
Our findings suggest that the ingestion of glucose solution improves maximal sprint performance. This ergogenic effect is unlikely to be related to sweetness since the aspartame trial had no effect on performance despite sweetness matching that of glucose. The benefit of glucose ingestion is also unlikely to result from a rise in blood glucose or insulin level as maltodextrin resulted in a similar rise but without affecting performance. In corroboration with the previous finding that the combined ingestion and mouth rinsing of glucose solution can improve sprint performance, we suggest that the ergogenic effect of glucose ingestion alone on maximal sprint performance is likely to be mediated via the stimulation of the glucose-sensitive receptors in the upper intestine.
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Contact
edwin_chong@sport.gov.sg

EFFECTS OF INGESTING A PLACEBO ON ENDURANCE PADDLING TRAINING

ATAEI, L.

UNIVERSITY OF NICOSIA

Introduction

The placebo effect is well known in accessing new medicines but beyond that placebos are now also starting to be used as ergogenic aids to enhance performance in athletes. (1). This study investigated the magnitude of the effect of an oral placebo intent to have similar effects of caffeine on endurance paddling training.
Methods
In a randomized crossover study design, participants underwent tests before and after a 7 day 'control' and placebo phases. Twelve well-trained club-level male dragon boat paddlers (mean ± SD: age, 25.2 ± 4.8 yr; body mass index, 21.9 ± 2.5 kg·m, Height 1.75±0.04 m, Weight 74.9±4.1 kg, VO2 max 58±3 ml•kg−1•min−1) completed 30 min of steady-state (SS) paddling on dragon boat ergo machines at approximately 55% VO2max followed by a 45 min energy based target time trial (TT). The paddlers were randomly divided into a Control and a Placebo groups. One hour prior to exercise each placebo group athlete consumed a capsule believing it to contain caffeine. While no intervention was given during the control phase, participants were asked to abstain from all dietary sources of caffeine, alcohol and strenuous exercise for the 24 hours preceding each experimental trial. In both trials the athletes were told not to divulge to any other athlete if they had been given a capsule or not. During each trial, VO2, VCO2 and RER, Ratings of Perceived Exertion (RPE) scale were collected every 10-min during the exercise. Heart rate (HR) was recorded every 15 min at rest and every 10 min during SS (2).
Results
Performance times were significantly improved ($p<0.05$) during the TT in the placebo groups compared to the control groups (41.35±1.48, 38.27±1.53 min respectively). Average power output during the TT was significantly greater for the placebo group compared with the control group (295±12 W, 275±22 W, respectively, $p<0.05$). However no substantial changes relative to each athletes baseline were observed in their mean heart rates. Follow-up interviews with each subject showed that they had experienced a 'placebo effect', such as pain reduction, less fatigued, clearer strategy thinking and reduced anxiety and arousal.
Conclusion
Compared to the control group, ingesting the placebo improved performance time by ~5.0%. The results suggest that the placebo effect could be used in a real life competitive environment to improve paddling performance.
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THE EFFECT OF PROTEIN INTAKE ON MUSCLE MASS, MUSCLE STRENGTH AND MUSCLE FUNCTION IN PHYSICALLY ACTIVE ELDERLY

NUIJTEN, M.A.H.1, TEN HAAF, D.S.M.1, DE VRIES, J.H.M.2, BONGERS, C.C.W.G.1, EIJSVOGELS, T.M.H.1, HOPMAN, M.T.E.1,2

1: RADBOUD INSTITUTE FOR HEALTH SCIENCES, RADBOUD UNIVERSITY MEDICAL CENTER, NIJMEGEN, THE NETHERLANDS. 2: DIVISION OF HUMAN NUTRITION, WAGENINGEN UNIVERSITY, WAGENINGEN, THE NETHERLANDS

Introduction
Protein intake and physical activity independently influence muscle mass, -strength and -function. The effect of protein intake in elderly has mainly been studied in vulnerable elderly, while with the increasing number of elderly it is of high interest to study the effect of protein intake in active elderly as well. The aim of this study was to determine the effect of amount and distribution of protein intake on muscle mass, -strength and -function in physically active elderly.
Methods
Protein intake and its distribution over the day were assessed by two 24-hr recalls. Participants were divided in a sufficient and non-sufficient protein intake group, based on the cutoff value of 1.2 g/kg bw/day. Evenness of distribution was calculated as coefficient of variance (CV). Based on the CV participants were divided in tertiles. Muscle mass, -strength and -function were measured by calf circumference, handgrip strength and Short Physical Performance Battery (SPPB), respectively.
Results
82 participants (79% male) with a median age of 83 years (82-93 years) were enrolled in this study. A sufficient protein intake was associated with smaller calf circumference in both males ($p=0.022$) and females ($p=0.036$), and with a higher SPPB score ($p=0.001$). Handgrip strength showed no significant differences between protein intake groups (all $p>0.05$). Regarding protein distribution pattern, no significant differences were found for calf circumference, handgrip strength or SPPB score (all $p>0.05$).
Discussion
Higher protein intake in physically active elderly seems to be related to improved muscle function, but this effect was not found for muscle strength. Distribution of protein intake had no effect on muscle mass, -strength and -function in active elderly.
Contact
Malou_nuijten@hotmail.com

AEROBIC-STRENGTH TRAINING AND DIET COMPOSITION IN RELATION WITH FUNCTIONAL STATUS, METABOLISM AND COGNITIVE FUNCTIONS IN ELDERLY INDIVIDUALS.

SLOBODOVÁ L., TIRPÁKOVA V., KRUMPOLEC P., VAJDA M., VALLOVÁ S., SEDLIAK M., CVEČKA J., ŠUTOVSKÝ S., TURČÁNI P., VALKOVIČ P., UKROPEC J., UKROPCOVÁ B.

FACULTY OF MEDICINE COMENIUS UNIVERSITY, INSTITUTE OF EXPERIMENTAL ENDOCRINOLOGY, BIOMEDICAL RESEARCH CENTER, SLOVAK ACADEMY OF SCIENCES, BRATISLAVA

Introduction
Regular physical exercise and diet composition represent key physiological and easily accessible means of preserving or improving functional status and cognitive functions in elderly individuals.
Methods
Seniors (age 66±8 years; SMI 10,45±1,22kg/m2) were recruited (cognitively healthy individuals M3/F2, individuals with mild cognitive impairment F2, patients with Parkinson´s disease M4/F4). Fenotyping was performed before and after training intervention. We asessed body composition (bioimpedance, Omron, Japan), Resting Metabolic Rate (RMR, indirect calorimetry), glucose tolerance (oral glucose tolerance test, oGTT), cognitive functions (Addenbrooke's Cognitive Examination, ACE-R; MemTrax) and physical activity (accelerometers, Baeck questionnaire). Diet composition was evaluated by 1-year retrospective nutritional questionnaire. Physical fitness (Rockport Walk Test), muscle strength (leg-press dynamometry) and muscle performance (10-Meter Walk Test by maximal or preferred speed, 10-MWT-

M/P; Chair Stand Test, CST) were assessed. Individuals were asked not to change diet during intervention which consisted of 12-weeks aerobic-strength training 3x1h/week, 60-70% VO2max or 60-70% 1RM, work load increased gradually.
Results
Twelve-week aerobic-strenght training improved functional capacity (10-MWT-M, p<0.01; 10MWT-P p<0.05; Rockport: VO2max, p<0.05) and cognitive functions (ACE-R: memory, p<0.05; MemTrax reaction time, p<0.001). Body composition, BMI, glucose tolerance and RMR did not change with training (p>0.05). Fasting and 2-hour glycemia were positively associated with meat intake (r=0.74, r=0.65 resp.; p<0.01) and 2h glycemia with intake of canned meat (r=0.63; p<0.01). Nuts&seeds intake was associated with higher MemTrax score (r=0.62; p<0.05) as well as with higher training-induced change in reaction time (MemTrax, r=0.61; p<0.05). Lower MemTrax score was associated with higher bread&bakery products intake (r=-0.86; p<0.0001). Negative correlation was observed between meat intake and ACE-R score (r=-0.66; p=0.01), specificaly in memory domain (r=-0.56; p<0.05). Higher legumes intake was associated with higher muscle strength (knee flexion: r=0.55, p<0.05; knee extension: r=0.76, p<0.01).
Discussion
Twelve weeks of aerobic-resistance training significantly improved functional capacity and cognitive function in the elderly. Long-term diet composition could affect health, functional state and possibly also dynamics of changes in functional capacity induced by regular exercise.

Oral presentations

OP-PM36 Physical activity and health promotion

NATURE OF APPROACHES TO PROMOTE PHYSICAL ACTIVITY IN BREAST CANCER SURVIVORS; LITERATURE REVIEW

GHOLIZADEH, Z.
FRIEDRICH-ALEXANDER-UNIVERSITY ERLANGEN-NURENBERG

Introduction
Physical activity is associated with clinically important positive effects on physical functions and quality of life in patients who had completed their treatment for cancer. Aim of this review is to know recent informational, behavioral and social, and environmental and policy approaches for physical activity promotion in this group.
Methods
Review of scientific literature was obtained by searching MEDLINE database with breast cancer, survivor, physical activity, exercise and promotion key words from 2000 to 2016. At first 62 were found but after reading abstracts those which was review study (11), no access to full text (1) and aim was assess biopsychosocial effects of interventions on breast cancer survivors (34) were excluded. Finally 16 articles were relevant and reviewed.
Results
Eight studies were randomized control trial and others peer review journal published articles. The most two performed interventions were computer based and telephone based. Informational interventions (print material, in person instruction, computer tailored newsletter, health care provider advice), behavioral and social interventions (telephone counseling, home-based exercise, web based self-management exercise, survivor testimony, pedometer based physical activity advice, peer delivered physical activity, community based wellness workshop) and any environmental and policy intervention. Some studies were used combination of informational and behavioral and social interventions. All of studies were theory and/or model based and the most popular theory was Social Cognitive Theory with the aim of physical activity behavior change. It followed with Trans Theoretical Model, Theory of Planed Behavior, Health Believe Model and mind fullness based cognitive theory, respectively and some studies were used two theories.
Discussion
All studies had report positive outcomes of their intervention. There is an increasing use of computer tailored interventions in recent years. Moreover the most important finding of this review is that all interventions are individual based. Amount of studies in compare with breast cancer prevalence and great effects of physical activity in this group is rather low
Recommendation: Breast cancer survivors need more attention from community and policy makers to prepare suitable situation for them to do physical activity and indulge its physical and mental and social effects. It would be more effective if beside beneficial individual interventions to empower people about physical activity, scientists perform community and organizational level interventions to promote physical activity in breast cancer survivors in their future research.
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Contact
sara.goliz@yahoo.com

UNDERSTANDING FOLLOW UP NON-ATTENDANCE TO A COMMUNITY-BASED PHYSICAL ACTIVITY MOTIVATIONAL INTERVIEW SESSION AMONGST AT-RISK INDIVIDUALS.

WADE, M.1,2, DANCY, B.2, MAJUMDAR, A.2, MANN, S.1,3
ST MARY'S UNIVERSITY

Introduction
A physically active lifestyle can help manage and prevent over 20 chronic conditions. The National Institute for Health and Clinical Excellence recommend the delivery of brief interventions for physical activity (PA) in primary care as both clinically and cost-effective in the long term. Ensuring that at-risk groups are sufficiently active is a major public health challenge. Motivational Interviewing (MI) is a client-centred method used to enhance intrinsic motivation to change. Let's Get Moving (LGM) is a programme provided from general medical practitioner (GP) surgeries offering MI to increase PA. This study focuses on first year results of the UK-based LGM programme delivered in Essex. The aim is to determine those least likely to attend a follow up, informing delivery and retention strategies.
Methods
Participants (n=616, M±SD age=55.8±12.4), identified by their local GP surgeries as being 18-74 years of age and a BMI between 28-35 attended a MI session with a local community exercise professional based at the surgery. The MI session encouraged participants to

increase their PA and attend local community exercise sessions. Measures at baseline were self-reported PA (days and time) using the International Physical Activity Questionnaire short-form (IPAQ). IPAQ data was analysed in line with the IPAQ data processing guidelines. Quantitative findings were analysed using appropriate descriptive and inferential statistics.
Results
A total of 277 participants did not attend the 12 week follow up. 22.9% aged between 41-50, 28.0% between 51-60, and 20.7% between 61-70 years, 63.0% were female, and 79.5% White British. 45.5% were classified as inactive, 36.1% minimally active, and 18.4% achieving health-enhancing physical activity (HEPA). Ongoing regression analysis will be used to determine if demographic and PA groups are significant indicators of non-attendance at a 12 week follow up MI session, full results will be available by the congress date.
Discussion
Initial data analysis indicates distinct demographic groups that did not attend a 12 week follow up appointment. Further, those most in need of support – individuals classified as inactive accounted for just under half of non-attendees. However, those classified as HEPA indicate potential positive non-attendance, as the services encouraged continued PA. Further analysis will provide indications as to the significance these groups have on attendance, informing retention strategies and refining delivery supporting an increase in PA.

AN EXPERIMENTAL FIELD-STUDY ON ACTIVE AND PASSIVE WORK BREAKS IN A STRESSFUL WORK ENVIRONMENT

SCHOLZ, A.1, GHADIRI, A.1, SINGH, U.1, WENDSCHE, J.2, PETERS, T.1, SCHNEIDER, S.3

1: UNIVERSITY OF APPLIED SCIENCES BONN-RHEIN-SIEG (SANKT AUGUSTIN), 2: FEDERAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (BAUA, DRESDEN), 3: GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Work breaks are known to have positive effects on employees' health, performance, and safety. However, prior research has focused mainly on their timing, duration, and frequency but less on break activities. Moreover, most studies examined work breaks in rather repetitive and physical demanding work. Thus, we conducted an experimental field study with a sample of employees' working in a stressful and cognitive demanding working environment and examined how different types of work breaks (boxing, deep relaxation, and usual breaks) affect participants' mood, cognitive performance, and neuro-physiological state.
Methods
In a repeated-measures experimental design in a real worksite, cognitive performance was assessed using an auditory Oddball test and the Movement Detection Test. Brain cortical activity was recorded using electroencephalography. Individual's mood was analysed using a profile of mood state. The work break types examined were exercising (boxing), deep relaxation and usual breaks compared to a control condition without any break.
Results
Although neurophysiological data showed improved relaxation of cortical state after boxing (vs. 'no break' and 'deep relaxation'), neither performance nor mood assessment showed similar results. Nevertheless, an overall work break type that is functional for rest breaks for all individuals could not be identified for the investigated highly demanding working environment.
Discussion
Within this study, the authors aimed to show that a specific work break type has positive effects on employees' mood and performance in a highly demanding working environment. Results of objective brain cortical activity showed a positive effect of a physically activating work break. Unfortunately, this positive neurophysiological effect was not reflected in cognitive performance and mood results. The mean value of most tests was inferior after no break, so the tendency of a positive effect of work breaks is visible. The mean results furthermore led to the assumption that mistakes can be reduced through any kind of work break. A general, functional kind of work break could not be identified through this study. Effects of different types of work breaks on employees' performance, mood and brain activity are highly individual. A variety of work break types can lead to a higher fulfilment of employees' needs on recreation and mood assessment.
Contact
andre.scholz@h-brs.de

PHYSICAL ACTIVITY AND BEHAVIORAL PATTERNS ASSOCIATED WITH MEDICINES USAGE IN MIDDLE-AGED ADULTS: A POPULATION BASED CROSS-SECTIONAL STUDY

KRASNIQI, E.1, BOSHNJAKU, A.2,3, BERISHA, I.3, SHULETA-QEHAJA, S.4, KONI, M.1

1: MEDICAL UNIVERSITY OF TIRANA (TIRANA, ALBANIA); 2: UNIVERSITY OF VIENNA (VIENNA, AUSTRIA), 3: UNIVERSITY OF GJAKOVA (GJAKOVË, KOSOVO), 4: KOSOVO MEDICINES AGENCY (PRISHTINË, KOSOVO)

Introduction
Physical activity (PA) is already seen as an important component of a healthy life (Mijnarends et al., 2016), with studies having demonstrated the effect of PA level in predicting mortality of patients suffering from chronic conditions (Myers et sl., 2002). This study analyzes the adherence phenomenon and possible correlation between active individuals and their educational status on the prevalence of medicines use.
Methods
This is an observational, cross-sectional study where a total number of 162 subjects aged 40-65 years old, residents of Kosova participated. Genders distribution was: 32.7% Males and 67.3% Females. Assessments of medication adherence and compliance, PA level, and education were made by reliable and validated questionnaires.
Results
Regarding medications compliance, 29.6% (32.1% Males and 28.4% Females) and 27.2% (22.6% Males and 29.3% Females) responded sometimes forgetting to take their medicines, respectively they stop taking them for reason other than forgetting. Meanwhile, 40.1% declared that they usually stop the medicine only because they feel better, 38.9% claimed to stop the medicine because they believe they are feeling worse, whereas more than half of our study responders declared having problem with buying the medicine. Interestingly, within our study population, subjects with higher levels of PA consumed significantly lower ($p<0.05$) amounts of medications.
Additionally, subjects with higher levels of education showed higher correlation with lower amounts of medication consumption .
Discussion
Results of this study suggest for certain lack of adherence and difficulties related to medicines use. One third of our subjects responded forgetting to take their regular medications, a serious phenomenon that that needs to be considered when righting prescriptions. Significant better ($p<0.05$) results in medicines usage in subjects with higher PA levels found in our population, stay consistent with other studies claiming the impact of PA in morbidity and in medicines usage in other populations from both developing and developed countries

(Bertoldi et al., 2016; Myers et al., 2002). Consequently this raises the need for public education on the medication adherence and life style factors such as PA in the success of the treatment.
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NATURE EXPERIENCES IN IMMERSIVE VIRTUAL ENVIRONMENTS: A NEW CONCEPT FOR GREEN EXERCISE STUDIES AND HEALTH PROMOTION

LITLESKARE, S.1, FAGERHEIM, K.1, HOLTHE, G.1, RYDGREN, T.1, BRAMBILLA, E.2, CALOGIURI, G.1

1: INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES (ELVERUM, NORWAY), 2: UNIVERISTY OF MILAN (MILAN, ITALY)

Introduction
Green exercise (any physical activity (PA) in presence of nature) provides additional health benefits compared to PA alone. Immersive Virtual Environments (IVE) offers potential benefits to research focused on understanding how individuals perceive and respond to different environments, and could therefore be a useful supplement in green exercise research, as it may provide a valid tool to conduct green exercise research indoors. IVE has emerged has a valuable option in environmental and behavioural studies (Smith, 2015), and in the field of health treatment and lifestyle-change interventions (Fox & Bailenson, 2009). Experiences of PA in IVE could also impact future PA adherence through mechanisms of reinforcement and enhanced self-efficacy. The purpose of this study is to develop and validate an IVE protocol to study the psychophysiological effects of IVE-based green exercise, and explore its potential for physical activity promotion.
Methods
The first phase of the study aims to define appropriate procedures to develop IVE videos, and find a safe and reliable manner to expose the participants to the IVE whilst walking on a manually driven treadmill (Woodway Curve). A 360° camera (Samsung Gear 360) and a custom made stabilizing device will be used to record the video, while a smartphone (Samsung Galaxy S7), VR-kit (Samsung Gear VR SM-R323) and headphones will be used to present the IVE. Pilot tests will be performed to evaluate and possibly adjust the protocol. In the second phase of the study, 60 college students will undergo three conditions: I) walk in a physical environment, II) walk with IVE, and III) sedentary IVE experience. The participants will be randomly assigned to one of two groups, undergoing all the three conditions either in a natural environment or in a built environment. Affective responses, perceived environmental potential for restoration, perceived exertion, heart rate, blood pressure and walking speed will be measured in concomitance with each condition. Perceived presence will be also measured after the IVE condition. Focus group interviews will be carried out with a selection of participants, in order to have a more in-depth understanding of the participants' perceptions.
Results
The study started the 1st January 2017. Preliminary findings will be presented at the 22th ECSS conference. These includes experiences from the pilot study and between groups comparison of quantitative data.
Discussion
This study will contribute to a better understanding of how IVE can supplement green exercise studies and PA promotion programs. Further studies might extend such knowledge to other fields, such as athletic performance, physical education and post-injury rehabilitation.
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Oral presentations

OP-PM46 Molecular Biology 2

SEVERE CALORIC RESTRICTION ELICITS NF-KBETA SIGNALLING IN HUMAN SKELETAL MUSCLE: INFLUENCE OF EXERCISE AND PROTEIN CONTENT IN THE DIET

MORALES-ALAMO, D.1, MARTÍN-RINCÓN, M.1, AZZINNARI, M.1, PÉREZ-SUÁREZ, I., SAID, M.1, HOLMBERG, H.C.2, CALBET, J.A.L.1

DEP. OF PHYSICAL EDUCATION IUIBS, ULPGC1; SWSRC, MID SWEDEN UNIVERSITY2

Introduction
The nuclear factor-kappaB (NF-kB) signalling pathway is activated by cellular stress (reactive oxygen species) and extracellular factors, mainly cytokines, growth factors and lipopolysaccharide. Phosphorylation of NF-kB-p65 at Ser536 increases its activation. Studies in rodents have shown that caloric restriction elicits skeletal muscle protein degradation via NF-kB signalling. Likewise, after resistance and eccentric exercise NF-kB signalling skeletal muscle in upregulated, however, the NF-kB signalling response to low-intensity exercise has not been characterized in human skeletal muscle. Moreover, it remains unknown whether the combination of caloric restriction and low-intensity exercise may promote NF-kB signalling and how this response is modulated by the diet.
Methods
Fifteen overweight men underwent 4 days of caloric restriction (CR) (0.8 g/kg BW/day of either whey protein (n=8) or sucrose (n=7) and low-intensity exercise (E) (45min of one-arm cranking and 8h walking/day). Muscle biopsies from both deltoid and one vastus lateralis (VL) were taken before (PRE), after CR+E and following 3 days of control (isoenergetic) diet (CD) with reduced exercise. Skeletal muscle Ser536-NF-kB-p65 phosphorylation and total protein expression were determined by Western blotting. Body composition was assessed by DEXA and statistical analysis performed using repeated-measures ANOVA.
Results
Before the intervention there was an association between Ser536-NF-kB -p65 expression in skeletal muscle and plasma free testosterone ($r=-0.53$, $p=0.04$) and cortisol-to-free testosterone ratio ($r=0.67$, $p=0.006$). During CR+E, the energy deficit was 5000 Kcal/d. Compared to PRE, Ser536-NF-kB-p65 phosphorylation was enhanced by 90% at CD ($p<0.05$). Compared to PRE, NF-kB -p65 total protein increased by 33 and 78% at CR+E and CD respectively ($p<0.05$). The type of supplements ingested did not affect the NF-kB signalling responses.

Greater protein expression levels of NF-kB -p65 total protein were observed in the arms than in the legs muscles ($p<0.05$), which could explain why the muscle mass lost was proportionally lower in the legs than in the arms after CD.
Discussion
This study reveals that the catabolic-to-anabolic index cortisol-to-free testosterone may be determining the basal activity of NF-kB in human skeletal muscle. We have demonstrated that caloric restriction increases NF-kB signalling in human skeletal muscle and that this effect is not attenuated by low-intensity exercise or the ingestion of whey protein compared sucrose.

SYNTHESIS, ABUNDANCE AND DEGRADATION RESPONSES OF HUMAN MUSCLE PROTEINS TO RESISTANCE EXERCISE TRAINING

BURNISTON, J.G., CAMERA, D.M., POGSON, M.A., HAWLEY, J.A.

LIVERPOOL JOHN MOORES UNIVERSITY

Introduction
Our objective was to use Dynamic Proteome Profiling to calculate the contributions of synthesis and degradation to exercise-induced changes in abundance on a protein by protein basis.
Methods
Two groups (n=8, in each) of age-matched (37 ± 5 y old), overweight (BMI: 26 ± 3), untrained (38 ± 6 VO2max ml/kg/ min) males consumed a high-fat diet (20% Carbohydrate, 65% Fat, 15% Protein) and ingested deuterium oxide (200 ml/ d) during a 9-day intervention period. Venous blood samples were collected daily and samples of vastus lateralis were collected prior to (i.e. day 0 control) and on days 3, 6 and 9 of the intervention. Participants were assigned either to a non-exercise group or an exercise group that performed resistance training (leg press, leg extension and dumbbell squats; each 4 x 10 repetitions at 80%1RM) on days 1, 4 and 7. Blood and muscle samples were analysed by mass spectrometry to determine precursor enrichment and the rate of incorporation of deuterium in to newly synthesised proteins. The relative abundance of each protein was analysed by label-free profiling and the contribution of protein degradation was then calculated.
Results
The average rate of synthesis of mixed sarcoplasmic proteins was similar in control (2.05 ± 0.15 %/d) and (2.19 ±0.17 %/d) exercised muscle. In the myofibrillar fraction, the average rate of synthesis was 45 % greater ($P<0.05$) in exercised (1.58 ± 0.08 %/d) compared to control (1.09 ± 0.06 %/d) muscles. In total, 90 proteins were included in the Dynamic Proteome Profiling and rates of synthesis spanned a range from 0.1 %/d (myomesin-2) to 24 %/d (carbonic anhydrase 3). In total, 28 proteins exhibited statistically significant differences in either synthesis rate or abundance in response to resistance training. The most common pattern of response was an increase in turnover, e.g. the synthesis rate of myosin heavy chain IIa was 2-fold greater in exercised muscle but there was no increase in abundance. Conversely, glycolytic enzymes including beta-enolase, phosphoglycerate mutase 2 and triosephosphate isomerase became significantly less abundant in exercise-trained muscle despite exhibiting no change or elevated rates of synthesis. This suggests protein degradation was increased to a greater extent than the measured rate of synthesis.
Discussion
Our findings provide empirical evidence that the contributions that synthesis and degradation make to changes in protein abundance induced by resistance exercise differs on a protein by protein basis.

THE DAMAGING EFFECTS OF RUGBY COMPETITION: ARE THESE ATHLETES IN A LEAGUE OF THEIR OWN?

MOREHEN, J., MORTON, J.P., CLOSE, G.L.

LIVERPOOL JOHN MOORES UNIVERSITY

Introduction
Rugby league (RL) is a high intensity collision sport, which places physical and metabolic stress on players during 80 minutes of match-play. Match-play causes structural damage and tissue trauma, which correlates to high impact collisions.
Methods
We therefore measured creatine kinase (CK) to identify damage and interleukin (IL) 4, 6 and 8 to measure inflammation in twelve professional RL players before and after a competitive match. Measures of heart rate (HR), absolute (m) and relative (m.min-1), match intensity, pre- and post-match blood samples were obtained.
Results
The mean post-match CK activity was significantly ($p<0.05$) greater than pre-match (68.5 ± 8.9 mU.mL.min-1 vs 39.6 ± 6.8 mU.mL.min-1). The mean post-match IL-4, -6, and -8 values were significantly greater than pre-match values ($p<0.05$) in all three IL's measured (2.60 ± 2.20 pg.mL vs 0.24 ± 0.32 pg.mL, 5.10 ± 2.11 pg.mL vs 2.87 ± 0.53 pg.mL and 1.64 ± 1.26 pg.mL vs 0.23 ± 0.40 pg.mL respectively). Although there were no significant differences between forwards and backs, individual data shows forwards experienced greater inflammation even when covering fewer metres per minute (89.1 ± 1.7 m.min-1 vs 93.4 ± 2.7 m.min-1) and at high intensity (12.2 ± 0.4 m.min-1 vs 13 ± 1.2 m.min-1) when compared to backs.
Discussion
This highlights the physical demands of forwards and may provide for the first time a way to identify the damage and inflammation caused between RL positions. In summary, we report for the first time augmented quantifiable values of IL-4, -6, and -8 concentrations, demonstrating the damaging effects of professional match play on markers of both muscle damage and notably inflammation.

THE APOPTOSIS PATHWAY AND GENETIC RISK FACTORS FOR ACUTE AND OVERUSE INJURIES

COLLINS, M., SEALE, K., HILL, L., BURGER, L., POSTHUMUS, M., SEPTEMBER, A.

UNIVERSITY OF CAPE TOWN

Introduction
The apoptosis pathway has been identified as biologically significant in the underlying pathogenesis of several degenerative conditions, such as neurodegeneration, osteoarthritis and tendinopathies. Variants within the apoptotic regulatory gene caspase-8 (CASP8) have been associated with altered risk for chronic Achilles tendinopathy (AT). Specifically, the del-C inferred haplotype constructed from rs3834129 (ins/del) and rs1045485 (G/C) was associated with reduced AT risk. The aim was to investigate the association of these CASP8

variants, together with rs13113 (T/A), with risk of other musculoskeletal injuries, specifically rotator cuff tears (RCT), ACL ruptures and carpal tunnel syndrome (CTS).
Methods
Three independent case-control cohorts were selected (1) a white South African cohort of 101 RCT cases and 101 healthy controls, (2) a Coloured South African cohort of 102 CTS cases and 148 healthy controls and (3) a Swedish cohort of 102 ACL cases and 116 healthy controls. Participants were genotyped for the three CASP8 variants using the TaqMan® allelic discrimination method. Potential associations were determined using the programming environment R and R packages.
Results
No independent genotype, allele or inferred haplotype associations were noted for any of the CASP8 variants with risk of RCT. Similarly, no independent genotype or allele associations were noted for any of the CASP8 variants with risk of ACL or non-contact ACL ruptures. The ins-G-T inferred haplotype constructed from rs3834129, rs1045485 and rs13113 was significantly associated with increased risk of ACL (p=0.029) and non-contact ACL ruptures (p=0.026) (26.8% CON, n=30; 38.8% ACL, n=40; 39.4% NON, n=29), while the ins-G-A inferred haplotype was significantly associated with decreased risk of ACL ruptures (p=0.037; 21.7% CON, n=24; 11.8% ACL, n=12). The del-C inferred haplotype constructed from rs3834129 and rs1045485 was also significantly associated with decreased risk of non-contact ACL ruptures (p=0.039; 13.5% CON, n=15; 5.6% NON, n=4). The AA genotype of the rs13113 variant was independently associated with increased risk of CTS (p=0.030; OR=5.88; 95% CI: 1.19 to 29.0), while the ins-G-A inferred haplotype was also significantly associated with increased risk of CTS (p=0.032; 6.8% CON, n=10; 13.4% CTS, n=14)
Conclusion
The novel associations of these haplotypes with additional musculoskeletal injury phenotypes further implicates CASP8 as a candidate gene for future investigation. The significant association of the del-C inferred haplotype with decreased non-contact ACL rupture risk, and the association of the complementary ins-G-A inferred haplotype with increased CTS risk, was in alignment with previous findings whereby the del-C haplotype was significantly associated with reduced AT risk. These results implicate the apoptosis pathway as biologically significant in the underlying pathogenesis of musculoskeletal injuries.

VASCULAR ENDOTHELIAL GROWTH FACTOR AND CAPILLARIZATION IN HUMAN SKELETAL MUSCLE IN RESPONSE TO ENDURANCE EXERCISE IN HYPOXIA, HYPEROXIA AND NORMOXIA

PRZYKLENK, A.1, GUTMANN, B.2, SCHIFFER, T.3, AUSSIEKER, T.1, HOLLMANN, W.4, STRÜDER, H.K.2, BLOCH, W.1, MIERAU, A.2, GEHLERT, S.1

GERMAN SPORT UNIVERSITY COLOGNE, GERMANY

Introduction
The effect of hypoxia (HY) and hyperoxia (PER) on vascular growth in human skeletal muscle in response to endurance exercise (EN) is still discussed. Thus, this study tested whether endurance exercise in HY, PER and normoxia (NOR) induces different regulation patterns in VEGF and skeletal muscle capillarization.
Methods
11 healthy male subjects performed unipedal cycling EN in HY, PER and NOR in a cross-over-design over four weeks in two training periods (each 3x30 min/week/leg) separated by a wash-out period of four weeks. Training was calculated from peak power output during exercise testing under the respective oxygen condition and conducted at the same relative intensity in all conditions. Skeletal muscle biopsies of m. vastus lateralis were collected at baseline (T0), after the first (T1) and last training session (T2). VEGF was determined via Western-Blotting at T0, T1 and T2. Capillary-to-fibre-ratio (C:F), capillary density (CD) and the number of capillary contacts per fiber (CC) in type-I and type-II fibers were determined by immuno-histochemical staining of capillaries with Caveolin-1 serving as read-out for capillarization at T0 and T2.
Results
EN workload during the study was significantly lower in HY vs. NOR and PER. VEGF decreased significantly in PER at T1 but remained unchanged in HY and NOR. CD increased significantly only in HY at T2. C:F did not change significantly in any of the conditions. CC significantly increased in HY in type I myofibres but was unchanged in type II fibers. There were no differences between conditions in VEGF, CD, C:F and CC.
Discussion
Despite no differences in VEGF and capillarization compared to NOR and PER, HY tendentially increased capillarization which is in line with other studies showing higher increases in capillarization in HY vs. NOR (Montero & Lundby, 2016). While absolute training workload was reduced in HY compared to PER and NOR, tendential increases in capillarization were observed. Although PER was shown to decrease capillarization and VEGF when applied chronically (Benderro, Sun, Kuang, & Lamanna, 2012), we could not detect an effect of PER on capillarization when combined with EN in human skeletal muscle. We conclude that short-term EN in HY can strengthen adaptive responses of skeletal muscle under circumstances when absolute training workload has to be reduced, while acute physiological work capacity tends to increase in PER without any detrimental effects on capillarization.
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Contact
A.Przyklenk@dshs-koeln.de

THE INTRA-/ INTERMUSCULAR FLUID AFTER SEVERE MUSCLE STRAIN INJURIES HAS A PRO-INFLAMMATORY PROFILE AND DIFFERENTIALLY AFFECTS ISOLATED MUSCLE AND CONNECTIVE TISSUE CELLS

BAYER, M.L., BANG, L., BECHSHØFT, C., OLESEN, J., KJÆR, M.

INSTITUTE OF SPORTS MEDICINE COPENHAGEN

Introduction

Muscle strains are traumatic injuries at the interface between skeletal muscle and the connective tissue. These injuries have a high incidence and substantial recurrence (Ekstrand et al., 2011). Acutely after strain injuries, a fluid accumulation (exudate) is found intra- and intermuscular (Koulouris et al., 2005). The composite of the exudate is unidentified and it is not known whether the change in the biochemical milieu is beneficial or detrimental to healing. It is also elusive whether isolated muscle-derived cells and connective tissue cells are stimulated or inhibited by the injury exudate.
Methods
Exudate was aspirated ultrasound-guided from 12 patients with a strain injury from 3 to 60 days after the injury. Simultaneously, blood samples were drawn for direct comparison. The cytokine and growth factor profile was determined by multiplex assays. Muscle and connective tissue cells were isolated from human donors and incubated with either exudate or plasma for measurement of cell proliferation.
Results
The exudate has substantially higher levels of IL-6, IL-8, VEGF and the chemokines MCP-1 and IP-10 compared to plasma ($p< 0.01$), independent of the time point at which the exudate was sampled. We found moderately elevated levels of TNF-a, IL-1b, IL-4, IL-10 and IL-15 in the exudate compared to plasma ($p< 0.05$), whereas IL-1a, IL-17 as well as GM-CSF were not different from plasma levels. There was no statistical difference between exudate and plasma levels of TGF-b1. Connective tissue cells proliferated stronger in the exudate compared to plasma ($p< 0.05$), whereas there was no difference in the growth rate of muscle-derived cells.
Discussion
High recurrence of muscle strain injuries suggest incomplete repair of damaged tissue, but underlying factors are unclear. Mediators impeding healing might be found in the intra-/ intermuscular fluid formed after a strain injury. We show that the exudate has a pro-inflammatory profile persisting over a prolonged time span. There was a difference in the growth rate of connective tissue cells as they were stimulated to proliferate more in the presence of the exudate. This could play an important role in connective tissue healing following strain injuries, but could potentially also lead to fibrosis.
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Contact
Monika.Lucia.Bayer@regionh.dk

Oral presentations

OP-PM48 Back pain in sports

PREVALENCE OF BACK PAIN IN ELITE ATHLETES AND A PHYSICALLY ACTIVE CONTROL GROUP

TROMPETER, K., FETT, D., PLATEN, P.
RUHR-UNIVERSITY BOCHUM

Introduction
The importance of physical activity in the treatment of back pain (BP) is generally accepted. However, an increase in physical activity has been suggested to be both a preventive factor and a possible risk factor for BP. It is well known that sports participation generally influences health in a positive way, but there is a lack of knowledge about the optimal dose-effect relation. In sports, BP is commonly reported to be a frequent disorder but it is still unclear if its prevalence is higher than in non-athletes. The aim of this investigation was to determine lifetime prevalence (LP), 12-months prevalence (12m-P) and point prevalence (PP) of BP in elite athletes compared to a physically active control group.
Methods
A standardized and validated questionnaire (Nordic questionnaire [Kourinka et al. 1987] and the questionnaire for grading the severity of chronic pain [von Korff et al. 1992] was sent to N≈4000 athletes from different sports disciplines by the German Olympic Sports Confederation, and to a control group of 253 physically sports students. Additionally a self-developed questionnaire focusing different aspects of training and competition was used to evaluate the athletic workloads.
Results
We received responses from 1,114 elite athletes (46.5% male and 53.1% female, mean age 20.9 years ± 4.8 years, mean height 176.5 ± 11.5 cm, mean weight 71.0 ± 10.3 kg) and 166 physically active sports students (74.7% male and 24.1 female, mean age 21.2 ± 2.0 years, mean height 180.0 ± 8.0 cm, mean weight 74.0 ± 14.5 kg). In elite athletes, LP of BP was 88.5%, 12m-P was 81.1%, and PP was 49.0%, compared with 80.7%, 69.9% and 42.8%, respectively in the control group. The LP and 12m-P were significantly higher in elite athletes than in the control group. Regarding the individual sports disciplines, the prevalence of BP was significantly higher in elite rowers, dancers, fencers, gymnasts, track and field athletes, figure skaters and marksmen, and those who play underwater rugby, water polo, basketball, hockey and ice hockey compared with the control group. The prevalence of back pain was significantly lower in elite triathletes.
Discussion
The results of this investigation indicate that BP is a present problem in German elite athletes. Especially disciplines with high mechanical loads on the spine seem to be affected. High training volume up to 45 hours/week might be associated with high prevalence rates. The results of this investigation underline the necessity of BP prevention in elite athletes.
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Contact
Katharina.Trompeter@rub.de
Acknowledgement
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CHRONIC LOW BACK PAIN - EFFECTS OF SUPPLEMENTAL HEAT THERAPY ON BIOMECHANICAL PARAMETERS

FREIWALD, J., BAUMGART, C., HOPPE, M.W.

BERGISCHE UNIVERSITY WUPPERTAL

Introduction
The beneficial effects of thermotherapy on analgesia and relaxation are widely known for various diseases. To date, however, thermotherapy in chronic low back pain is internationally not explicitly recommended in guidelines (Koes et al., 2010). The effects of thermotherapy on biomechanical parameters within a multimodal back pain treatment concept are unknown as well (Heymans et al., 2005; van Middelkoop et al., 2011; Poquet N et al., 2016).
Methods
Within a multimodal treatment concept 184 patients with chronic low back pain were treated either with (n=92) or without (n=92) supplemental heat wrap therapy. The patient's strength and flexibility was measured by analyzing biomechanical parameters at baseline and after three months of treatment.
Results
Strength and flexibility of all patients improved within the multimodal treatment. Participants receiving heat wrap therapy supplemental to basic multimodal treatment showed a statistically significant improvement in torque and flexibility of the trunk musculature as compared to those conducting only the multimodal treatment regarding extension ($P = 0.09$, $f = 0.01$, $[1-\beta] = 0.41$), rotation to the right ($P = 0.09$, $f = 0.01$, $[1 \beta] = 0.41$) and rotation to the left ($P = 0.08$, $f = 0.01$, $[1 \beta] = 0.42$).
Discussion
The supplemental use of heat wraps in patients with chronic low back pain receiving a multimodal treatment over three months provided significant benefit in mobility of the thoracic and lumbar spine regarding the range of motion as well as the torque of the trunk musculature. The underlying physiological conditions and possible explanations for the results were discussed. The implementation of heat wrap therapy in daily clinical practice additional to an individualized multimodal treatment concept can be recommended.
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CAN PHYSICAL PERFORMANCE PREDICT LOW BACK PAIN?

KREUZPOINTNER, F., ERHARDT, R., EIBL, F., SCHWIRTZ, A.

TECHNISCHE UNIVERSITÄT MÜNCHEN

Introduction
Lower back pain is a public health disaster. Many people suffer from it and the onset is to the greatest possible extent unknown. There are many risk factors inducing the occurrence of LBP. Borkan et al. (2002) promote a combination of encouraging activity, reassurance, short-term symptom control and describe LBP as a multifactorial biopsychosocial pain syndrome [1].
Physical activity might explain a big portion. We therefore conduct a systematic review (SR) including several parameters predicting the human physical performance: age, sex, BMI, body weight, body height, body fat percentage, strength, flexibility, blood pressure, somatotype, balance and endurance.
Methods
This review intended to encompass longitudinal studies and prospective studies maintaining a healthy baseline to discover the onset of LBP. Publications were identified from four electronic databases: Pubmed, SportDiscus, Web of Science and the Cochrane Database. The quality of the studies were assessed by the Cochrane's Tool to Assess Bias in Cohort Studies.
Results
Finally 21 out of 8228 articles were included after a strict selection process. Given the eligibility criteria the literature research identifies results for all parameters except for balance and body fat percentage. Strength for example was studied in nine included publications. There are different tests to measure strength ability at baseline. Nearly none of the included papers can clearly predict the future onset of low back pain. Whereas other parameter like BMI, sex or age are suited to predict LBP. Most of the studies present risk ratios or odds ratios. Many authors work with subgroups to identify risk groups for the onset of LBP. All in all the results of the SR show small effect sizes and often high confidence intervals.
Discussion
This systematic review depict Low Back Pain as a complex and multidimensional problem. This problem leads to the fact that effect sizes are very small and the variance rather high. Given the fact that this SR is the first one covering such a broad field of physical performance, we can extract that it is very important to find mixed models combining all parameters to generate a preventive profile predicting LBP. Therefore, we want to conduct a MegaTrail to compare the facts from the literature with that from the database of eGym GmbH. The database consist of n=xyz entries. It is very important to bring all knowledge from the various parameters together to predict LBP from physical parameters.
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WHAT ARE THE RISK FACTORS FOR LOW BACK PAIN IN KAYAKERS?

JUNKO, W.1, TAKESHI, T.1, SHIRO, S.1,2, KEITA, N.1, SATORU, N.1

1NISHIKAWA ORTHOPAEDIC CLINIC 2DEPARTMENT OF ORTHOPAEDIC SURGERY, GRADUATE SCHOOL OF MEDICINE, CHIBA UNIVERSITY

Introduction

In many sporting activities, a decrease in performance is correlated to concomitant health conditions. In kayakers, low back pain (LBP) is a common musculoskeletal complaint and is one of the most common reasons for time away from the sport. In various sports, a study has investigated risk factors for LBP. However, risk factors for LBP in kayakers have not been elucidated. The purpose of this study was to investigate risk factors for LBP in kayakers.
Methods
The subjects were 20 high school student kayakers (age: 17.9 ± 0.8 years; males: 13, females: 7). They were evaluated by a questionnaire regarding symptomatic body areas and were divided into two groups based on the presence (LBP group: n = 6; age: 17.5 ± 0.5 years; males: 2, females: 4) or absence (non-LBP group: n = 14; age: 17.9 ± 1.2 years; males: 11, females: 3) of LBP. In addition, all participants underwent the following physical examinations: wing test (WT, evaluation of trunk rotation), horizontal shoulder flexion test (HFT), full squatting test (FST), heel–buttock distance (HBD), straight leg raise (SLR), shoulder internal/external rotation test (SRT), Thomas test (TT), and modified floor–finger distance (FFD). All parameters, with the exception of FFD, were evaluated by averaging the right/left test results. To compare group differences, each parameter was analyzed using an unpaired t test.
Results
In the 20 participants, the right/left average results of each test were as follows (LBP group/non-LBP group): WT (20.9/18.3, p = 0.39), HFT (1.39/1.41, p = 0.96), FST (1.25/1.50, p = 0.48), HBD (1.54/1.83, p = 0.28), SLR (87.50/95.00, p = 0.02), SRT (0.92/0.91, p = 0.96), TT (0.50/0.67, p = 0.52), and FFD (1.75/2.41, p = 0.20). Only SLR parameters showed a significant difference between the two groups.
Discussion
This study showed that the LBP group had a significantly higher SLR range than the non-LBP group. It has been reported that hamstring stiffness could contribute to LBP probably because of the indirect involvement of tight hamstrings in the LBP pathogenesis. However, this study suggested that LBP in high school student kayakers was provoked by flexible hamstrings. Therefore, further studies are needed to confirm flexible hamstrings as an LBP mechanism in kayakers.
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Contact
jun.mc0528@gmail.com

CLINICAL OUTCOME OF ISOLATED LUMBAR EXTENSION RESISTANCE TRAINING FOR CHRONIC LOWER BACK PAIN – A RETROSPECTIVE STUDY ON 626 PATIENTS

SPANG, C.1,2, WAGENBLAST, F.3, HAAS, D.2, ALFEN, F.M.2
1: UMEA UNIVERSITY (SWEDEN), 2: DR. ALFEN SPINE CENTER (WÜRZBURG,GERMANY), 3: UNIVERSITY OF TÜBINGEN (GERMANY)

Introduction
Chronic lower back pain is the most common painful musculoskeletal condition worldwide and its treatment can often be challenging. It has been suggested that neuromuscular deficits may be a key factor and that specific and isolated lumbar extension resistance training can improve the condition (Steele et al., 2015). However, there is a lack of studies on large patient materials.
Methods
In a retrospective study the outcome of isolated lumbar extension resistance training in 626 consecutive patients with lower back pain (222 women, 404 men; mean age 50 years, range 18-78 years) was statistically analyzed. The patients underwent 18-25 exercise sessions 2 times per week. Pain scores were taken before and after the treatment. Information about activity levels and pain duration was noted before the therapy. Back muscle strength was measured by a static test during the first and last training session. The strength levels were compared to a data set collected from healthy individuals.
Results
At the beginning of the treatment the strength deficit compared to healthy individuals was on average 45.49% (SD 20.62). After the treatment the mean deficit was 18.31% (SD 17.14). There was a significant increase of strength after the therapy (mean 27.08%, SD 20.27) ($p<0.01$). 597 patients (95.4%) kept or improved their strength levels. 554 patients (88.5%) reported pain relief or maintenance. The improvement of symptoms based on the pain scores was highly significant (17.1%) ($p<0.01$). The effectiveness of the treatment seemed to correlate with the level of symptoms at the beginning ($p<0.01$) and also with the total increase of strength levels during the therapy ($p<0.01$). The duration of pain and the activity levels had no influence on the outcome.
Discussion
The results of this study show that isolated lumbar extension resistance training is an effective treatment option for patients with lower back pain. The correlation of the outcome with the levels of symptoms before the therapy and also with the total increase of strength during the therapy are interesting points for further studies.
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Contact
Christoph.spang@umu.se

EFFECTS OF SENSORIMOTOR TRAINING INTERVENTION ON TRUNK STABILITY AND BACK PAIN

FETT, D., HENTZ, C., PLATEN, P.
RUHR-UNIVERSITY BOCHUM

Introduction
Low back pain (LBP) is a common condition. It is reported to be a major health and socioeconomic problem which may lead to limited functioning in everyday life. It impairs the quality of work and is the leading cause of activity limitation and absence from work. One proposed mechanism for non-specific LBP is lack of stability of the spine [Panjabi 2006]. Previous studies have demonstrated that patients with LBP may have impairments in the control of the deep trunk muscles which are responsible for maintaining the coordination and stability of the spine [Hodges et al. 1998]. Motor control intervention focuses on the activation of the deep trunk muscles and targets the restoration of control and coordination of these muscles, progressing to more complex and functional tasks integrating the activation of deep and global trunk muscles [Saragiotto et al. 2016].

The purpose of this study was to test the feasibility and efficacy of a modified version of the MiSpEx sensorimotor training intervention [4] in setting of university sports.
Methods
40 healthy subjects (34 females, 6 males, 26.5 ± 7.3 years, 171.7 ± 9 cm, 64.7 ± 9.2 kg) participated in this study and were assigned to a 12-week training program. The intervention consisted of sensorimotor exercises for core stability with additive perturbation elements. It took place once a week for 60 minutes. Before and after the intervention all participants underwent several tests to measure effects of the training. Pain intensity, level of physical activity, center of pressure (COP), counter movement jump, range of motion, isokinetic trunk force and feasibility were measured.
Results
Participants showed significantly improved values of one leg COP (right: 1325.8 ± 312.8 mm vs 1195.1 ± 267.9 mm; left: 1324.2 ± 270.7 mm vs 1257.8 ± 272.5 mm) and isokinetic trunk extension force (194.9 ± 55.1 Nm vs 208.3 ± 59.4 Nm). Furthermore, participants indicated significant less LBP and disability during the last three months.
Discussion
The present study gives first indications for effects of motor control exercise targeting neuromuscular factors like kinematics, strength, postural control and pain. In addition the participants showed high acceptance to and satisfaction with the training program by regular participation and positive acknowledgements in a feasibility questionnaire. A strength of the intervention implemented is the symbiosis of the hypothesized large and clinically relevant effect and the low weekly training volume as well as the low demand for resources, which makes it a cost-effective intervention [Niederer et al. 2016].
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Contact
daniela.fett@rub.de
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Oral presentations

OP-PM55 Boxing and the eye: mixed session

ACUTE BRAIN CHANGES FOLLOWING ROUTINE SUB-CONCUSSIVE IMPACTS: EVIDENCE FROM BOXING

DI VIRGILIO, T.G., HUNTER, A.M., WILSON, L., STEWART, W., DONALDSON, D.I., IETSWAART, M.
UNIVERSITY OF STIRLING

Introduction
Repetitive concussive episodes on brain function are associated with risk of long-term sequelae (chronic traumatic encephalopathy) (Broglio et al, 2012; Baugh et al, 2012; McKee et al, 2014). Repetitive sub-concussive head impacts (RSHIs) may have similar consequences (Gavett et al, 2011; Ling et al, 2017); we recently demonstrated that soccer ball heading results in acute changes to brain function (Di Virgilio et al, 2016), but we are unsure if a similar effect exists following other contact sports. Therefore, the aim of the study was to assess whether sub-concussion from boxing sparring results in similar alterations.
Methods
Twenty amateur boxers (age 21.1±1.5) performed a sparring bout (3 x 3 minute rounds) modelling a routine training session. Primary outcome measure of corticomotor inhibition, measured using transcranial magnetic stimulation, was assessed prior to sparring and again immediately, 1h and 24h post-sparring. Secondary outcome measures (corticospinal excitability, cognitive function, motor unit recruitment strategy) were also recorded.
Results
Corticomotor inhibition significantly increased 1h following sparring (p=0.03; CI 0.002937 to 0.1107); this increase appears to be transient, with values returning to baseline levels by the 24h follow up. Corticospinal excitability decreased significantly 24h post-sparring when compared to the 1h follow up (p=0.01; CI 2.403 to 24.64), but did not differ significantly from baseline. Paired associate learning (PAL ñ memory performance) was decreased following sparring (p=0.018; CI 0.1051 to 1.217) and remained in a similar state at the 24h follow up, though not significant (p=0.07). A decline was shown 1h post in the slope coefficient between motor unit recruitment threshold and firing rate (p=0.02; CI -0.2876 to -0.03142). Other cognitive function subtasks remained unchanged.
Discussion
Boxing sparring resulted in acute and transient electrophysiological and cognitive changes similar to that of soccer heading. In addition the increased inhibition shown 1h post-sparring, likely caused a decline in recruitment of high threshold motor units. This may impair motor control but further study would need to establish this.
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Contact
td13@stir.ac.uk

EFFECT OF THE APPLIED ANCIENT BOXING EXERCISE ON STRENGTH OF LOWER EXTREMITIES AND QUALITY OF LIFE IN WARICHAPHUM SAKONNAKON PROVINCE OSTEOARTHRITIS: A RANDOMIZED CONTROLLED TRIAL

KATIYAJAN, N.

KHONKAEN UNIVERSITY

Introduction
Osteoarthritis (OA) is one of the most common causes of disability due to limitations of joint movement. Exercises that increase balance, flexibility, and range of motion are recommended for patients with OA. The applied ancient boxing exercise, which is the kind of exercise adapted from traditional boxing posture. The applied ancient boxing exercise is low impact, suitable for balance training and good coordination. The objective of the study was to investigated the effect of the applied ancient boxing exercise on the muscle strength of lower extremities and an quality of life (QoL) in patients with OA who live in Waritchaphum, Sakon Nakhon.
Methods
This research study was a randomized control trial. Twenty subjects recruited from the community and randomly allocated into two groups, control group (CG) and the experimental group (EG). The CG (n=10) received health education and the EG (n= 10) performed the ancient boxing. Both group had their anthropometric measurements blood pressure, resting heart rate, five time sit to stand test (FTSST) and QoL at before (week 0), week 4 , week 8 and immediately after the completion of program (week 12).
Results
The EG had a significantly greater FTSST than CG after 4 weeks ($p<0.05$) while QoL had no statistically significant difference when compared between group ($p>0.05$). According, either as week 8 and week 12 the EG had a statistically significant difference of FTSST which compared with CG ($p<0.05$). In contrast, QoL had no statistically significant difference which compared with CG ($p<0.05$).
Discussion
The applied ancient boxing exercise could be improved muscle strength of lower extremities but no affected to QoL after 4 weeks of program which may be due to subjects with chronic OA knee, there is no violence to the lifestyle. However, researchers have also seen the benefits of this study in terms of preventing the progression of patients with OA. Future studies should continue to be focused on patients with OA in the higher levels to improve the quality of life of residents in the following areas.
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Contact
Fonkitty_123@hotmail.com

THE MODIFIED ANCIENT BOXING EXERCISE ON PHYSICAL PERFORMANCE IN THAI ELDERLY: A RANDOMIZED CONTROLLED TRIAL

SRISAMAI, T.

KHONKAEN UNIVERSITY

Introduction
Elderly people are increasing continuously in several countries. Anatomy and physiology of the elderly may change and reduce physical performance. This study was investigated the effect of the modified ancient boxing exercise program and physical performances in Thai elderly.
Methods
There were 20 subjects enrolled in the study. The control group (n=10) did not undergo modified ancient boxing exercise but received health education and remained their activity daily livings. The experimental group (n=10) received modified ancient boxing exercise program for 3 times per week, 40 min per time for 12 weeks. Cardiovascular endurance and physical performance were measured before and immediately after the program (12 weeks).
Results
The results presented that Six minute walk test (6MWT), in the control group were not significantly different after program but time up and go test (TUGT) showed significantly increased of scores (pre : 8.06±1.63 seconds, post : 8.65±2.04 seconds $p<0.05$). In contrast, the subjects in the experimental group showed significantly increased of the scores of 6MWT (pre: 473.5±53.79 meters, post: 496.5±52.39 meters $p<0.001$). The subjects in the experimental group also showed significantly decreased of the scores of TUGT (pre: 9.09 ± 1.63 seconds, post: 7.47 ± 1.18 seconds $p<0.05$).
Discussion
This study was designed to evaluate the effects of 12-weeks modified ancient boxing exercise program in physical performance in Thailand older adults. Physical performance parameters (6MWT, TUGT) were significantly improved after 12 weeks. At the end of study, TUGT in control subjects were significantly worse than the baseline. These data indicated that mobility and stability were improved by modified ancient boxing exercise program and worsen without exercise in the duration of 12 weeks. In conclusion, the modified ancient boxing exercise program is appropriate for the healthy elderly subjects. Physical performance significantly improved in the 12 week-course of the modified ancient boxing exercise program.
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Contact
Thitipa.s@hotmail.com

THE ASSOCIATION BETWEEN INTRAOCULAR PRESSURE AND BLOOD PRESSURE DURING A MAXIMAL INCREMENTAL TEST

VERA, J.1, JIMÉNEZ, R.1, MADINABEITIA, I.2, REDONDO, B.1, PAULAUSKAS, R.3, CÁRDENAS, D.2
UNIVERSITY OF GRANADA

Introduction
The execution of highly demanding physical exercise has demonstrated to induce an acute increase in intraocular pressure (IOP) and blood pressure (BP) (Bakke et al., 2007, 2009). This study aimed to explore the effect on IOP and BP of a maximal incremental test on a treadmill.
Methods
Sixteen physically active males (37.81 ± 8.83 years old) voluntarily participated in this investigation. IOP and BP were measured in different moments: before physical effort, just after the maximal incremental test, after 5 minutes of active recovery, and after 15 minutes of passive recovery
Results
A repeated measures ANOVA, using the measurement moment as the within-subjects factor, showed an effect of maximal incremental effort on IOP ($F=16.747$, $p < 0.01$, $\eta p^2 = 1$) and BP ($F = 32.966$, $p < 0.01$, $\eta p^2 = 1$ and $F = 24.863$ $p < 0.01$, $\eta p^2 = 1$ for systolic and diastolic arterial blood pressure, respectively). There was a moderate positive association between IOP and systolic and diastolic BP in the different measurement moments. The Pearson correlation values were 0.85 and 0.78 before physical effort, 0.75 and 0.70 just after the maximal test, 0.73 and 0.70 after 5 minutes of active recovery, and 0.73 and 0.71 after 15 minutes of passive for the relationship between IOP with systolic and diastolic blood pressure, respectively.
Discussion
We conclude that acute performance of a maximal incremental physical effort lead to a significant increase of IOP and BP, and these indices fully returned to baseline levels after 5 minutes of active recovery. This study demonstrates a potential relationship between IOP and BP before and after physical effort, so that IOP may be used as a new physiological indicator of physical effort. The rapid, easy and well tolerated measure of IOP makes it especially relevant in applied contexts (Vera et al., 2017).
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Contact
jesusvv@correo.ugr.es

VISUAL REQUIREMENTS AND VISUAL PERFORMANCE PROFILE IN FOOTBALL

OERTZEN-HAGEMANN, V., JENDRUSCH, G., PLATEN, P.
RUHR-UNIVERSITÄT BOCHUM

Introduction
The quality of eye-foot- and eye-head-coordination, respectively, and the peripheral information input influence the success of a football player in a match. A basic pre-condition for secure and optimal (related to the individual exercise capacity) sporting and movement control is good eyesight. The purpose of this study was to generate a multidimensional visual performance profile of professional German football players and to compare this profile with former published eye test data [1, 2].
Methods
In this study 42 German Football League Players (first division players; average age: 23.7 ± 4.2 years) were tested with regards to their visual performance (visual acuity, motion perception, contrast sensitivity, refractive errors (e.g. nearsightedness/myopia or astigmatism), depth and color perception.
Results
About 11.9% of athletes use glasses or contact lenses (for distance perception) for daily use. 20.0% of athletes with ametropia are practicing football without an optical correction. On one hand, there was a lack of awareness about the effect of visual performance on sporting performance, on the other hand the correction used was unsuitable for playing sports or the correction was poor in relation to wearing comfort. The median of the (monocular) visual acuity was about 2.00 for the left and the right eye (with maximum-values considerably above 2.50). Altogether 26.2% of the professional football players are detected as ametropic and thus in need of optical correction. 7.2% of the football players tested had deficits in depth perception, approximately 11.0% in contrast sensitivity. 11.9% showed a color asthenopia (red-green). The mean score of dynamic visual performance was 82.4 ± 9.8%.
Discussion
To summarize, vision is of crucial importance for movement control and balance regulation. Vision promotes anticipation, e.g. fast movements as well as potential accident risks e.g. in one-on-one-situations in football. Professional football players achieved a visual performance profile and a rate of ametropia (26.2%) comparably to other elite athletes of different sports [1, 2]. The latter shows that visual function tests should be an inherent part in health diagnostics of football players in order to be able to detect and (consequently) correct visual deficiencies at an early stage. Furthermore, visual functions should be controlled regularly.
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THE EFFECT OF PHYSIOLOGICAL AROUSAL ON THE QUIET EYE OF ELITE BADMINTON PLAYERS.

GAWIN, W., STEIN, J.P., FRIES, U., GAUDEL, J., ZWINGMANN, K., VOELCKER-REHAGE, C.
TECHNISCHE UNIVERSITÄT CHEMNITZ

Introduction
It has been shown that elite athletes use a longer final visual fixation before executing a motor task (QE) than nonelite performers (e.g. Vickers, 2016). The prolonged QE leads to more focused attention and a better performance (e.g. Mann, Williams, Ward & Janelle, 2007).

However, psychological or physiological strain affects the quiet eye and the performance negatively (Vickers & Williams, 2007). Due to its intermittent game structure with high intensity intervals, elite badminton constitutes a sport with high mental and physiological demands. We assumed that elite badminton players show shorter fixations when acting under physiological strain and that the players' concentration capacity correlates with their QE under pressure.
Methods
In two game situations 'service return in doubles' and 'smash defense in singles', the gaze behavior of 10 doubles players (9 female, 1 male, age 20,8 ± 4,8) and 7 singles players (5 female, 2 male, age 20,6 ± 5,0) was recorded by a mobile eye tracker (SMI ETG 2w). The participants were national junior players or senior players of the German badminton national team. Each player had to execute either service return or smash defense motor tasks with low, medium, and high level of physiological arousal. The duration of the final fixation was recorded, and the concentration capacity was measured with the d2-R test.
Results
The average QE duration ranged from 783 ms to 857 ms (doubles) and from 731 to 790 ms (singles). Between the three conditions, we found no statistically significant difference in QE. However, some players reduced the duration of the QE significantly while other players reacted with a prolongation. The difference score of the QE duration and the d2-R concentration score correlate statistically significant in doubles players ($r = .70$, $p = .026$).
Discussion
Overall, we found no reduction of the QE induced by physiological strain. The individual duration of the quiet eye appears to vary significantly: Some players increase the QE while other players "collapse". Doubles players with a high concentration score seem to be able to sustain or even to prolong their QE under physiological pressure conditions.
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Contact
wolf.gawin@hsw.tu-chemnitz.de
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Oral presentations

OP-BN16 Biomechanics of Jumping

DIFFERENT MOTION PATTERNS DURING FORWARD JUMP LANDING IN ATHLETES WITHCHRONIC ANKLE INSTABILITY, ANKLE SPRAIN COPERS AND HEALTHY CONTROLS

LIN, J.Z., LEE, H.J.
NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction
Lateral ankle sprain (LAS) was one of the most common sports-related injuries (Park & Singh, 2014). People who have sprained their ankles but have no residual symptoms were defined as copers. Individuals who had suffered a LAS would eventually develop into chronic ankle instability (CAI). Therefore, the purpose of this study was to investigate kinematics parameters among healthy individuals, copers and CAIs when performing forward jump-landings.
Methods
There were 30 collegiate athletes (10 healthy controls, 10 copers, and 10 CAIs) volunteered for this study. All groups had to report a Cumberland Ankle Instability Tool. Kinematics data were collected by 10 VICON cameras at 200 Hz. During the experiment, participants were asked to perform a single-leg forward jump over a 15 cm high hurdle and followed with a single-leg landing on the ground. One-way ANOVA was conducted to compare the differences in lower extremity joint kinematics during jump landing among the healthy, copers, and CAIs ($P < .05$). Post hoc comparisons were performed using the Scheffe's test.
Results
The CAIs and copers showed significantly greater ankle eversion angle and ankle inversion angular velocity than the control group during the landing phase. At the initial and the lowest point of landing phase, the CAIs demonstrated a significant greater hip flexion angle than the control group. The CAIs and copers both demonstrated significantly greater hip adduction angles compared to the control group at the maximum knee flexion angle.
Discussion
At the initial landing, the movement strategy of copers was similar to CAIs. Both were demonstrated a significant greater hip flexion and adduction angles. It was suggested that even one ankle sprain could cause a long-term deficit in movement control other than healthy controls. A significant greater ankle inversion angular velocity was discovered at initial single leg landing of the copers and CAIs. In addition, during the descent after the initial landing, the copers and CAIs utilized more ankle eversion angle to help stabilize the ankle and avoid the occurrence of ankle inversion. Movement at the ankle is key to maintain posture and balance, it requires sufficient muscle activations to complete the task. Without sufficient muscle strength or activation might cause greater and faster joint motion which would hamper the control of ankle joint stability. This finding might be one of the keys related to re-injury factor, especially for the copers. The combination of a better neuromuscular control around ankle joint and a compensatory hip joint strategy could help copers to avoid re-injuries and reduce the possibility becoming CAIs.
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Contact
hjlee@ntnu.edu.tw

DOES THE FOOT MUSCLE STRENGTH RELATE TO THE POSTURAL STABILITY?

KOYAMA, K.1, NAGAFUJI, Y.1, YAMAUCHI, J.2,3

1. TOIN UNIVERSITY OF YOKOHAMA, KANAGAWA, JAPAN 2. TOKYO METROPOLITAN UNIVERSITY, JAPAN 3. FUTURE INSTITUTE FOR SPORT SCIENCES, JAPAN

Introduction
Cutaneous sensation on the plantar sole plays an important role in postural control (Wang and Lin 2008). Also, the foot muscle strength is considered to be an important contributor for balance and functional ability in elderly people (Menz et al. 2005). The stronger foot muscle strength might relate to the better postural stability if the foot muscle strength is required to maintain a body balance. However, there are no studies how the foot muscle strength affects to the postural stability.
The aim of this study was to examine the relationship between the foot muscle strength and the postural stability and the influence of the foot muscle strength to the postural stability after the foot muscle strength training.
Methods
Total thirty-seven healthy subjects were measured their toe flexor strength (TFS) and postural stability on the dynamometer and the force plate, respectively. Postural stability was evaluated from the path of the center of pressure (COP) during double- and single-leg standing tasks for 30s. Total range (TR), mean velocity (MV), total area (TA) and TR per unit area (TR/A) were calculated from COP data. In Exp I, relationships between TFS and COP variables were determined. In Exp II, subjects (n = 17) performed a 12-week foot muscle strength training program for 3 days per week and their TFS and postural stability were measured before and after the training period. The exercise program consisted of the ladder and mini-hurdle, the balance ball, the calf-raise, and the towel-gathering exercises.
Results
In Exp I, it was found that the stronger TFS was not related to the better COP (i.e, shorter TR, slower MV and smaller TA). In Exp II, TFS increased significantly after the training period compared with before (TFS: 177.7 ± 47.3 vs. 237.2 ± 47.6 N, $p < 0.01$), while COP in the double-leg standing was not changed after the training, but TR, TA and MV in the single-leg standing decreased significantly after the training compared with before (TR: 78.9 ± 15.2 vs. 61.4 ± 12.6 cm, $p < 0.01$; MV: 3.9 ± 0.8 vs. 3.1 ± 0.6 cm/sec, $p < 0.01$; TA: 5.2 ± 2.2 vs. 4.1 ± 1.5 cm2, $p < 0.05$). There were no significant correlations between changes in TFS and changes in COP variables after the training under all conditions.
Discussion
This study demonstrated that the foot muscle strength might not be directly related to the postural stability and other factors of the foot function could influence to the improvement of postural control.
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MUSCLE ACTIVITY ONSET DURING LANDING FOLLOWING ACL RECONSTRUCTION

THEISEN, D., GETTE, P., MEYER, C., SEIL, R.

LUXEMBOURG INSTITUTE OF HEALTH

Introduction
Full return to sport following anterior cruciate ligament reconstruction (ACLR) is compromised in a considerable proportion of patients. While rehabilitation strongly focuses on the recovery of muscle strength, delayed activation of muscles may play a crucial role in the restoration of dynamic knee function. We hypothesised that muscle activation prior to landing from a drop vertical jump (DVJ) would be delayed in the injured limbs of rehabilitated patients with ACLR when compared to their uninvolved limb and uninjured control participants.
Methods
This pilot study concerned 10 patients with ACLR (8 males, 2 females; BMI: 23.2±2.4 kg/m2; age: 24.5±6.8 years; time since surgery: 8.7±1.4 months; grafts: 5 bone-patellar-tendon-bone, 5 semitendinosus) and 10 healthy controls (8 males, 2 females; BMI: 22.5±2.1 kg/m2; age: 24.9±4.6 years). Each participant performed 3 bilateral DVJ from a 40 cm box, landing with each foot onto a separate force plate recording 3-D ground reaction forces at 1.000 Hz. Synchronised electromyographic activity was registered (1.500 Hz) via surface electrodes in the medial and lateral vastii (VM, VL) and the medial and lateral hamstring (MH, LH) muscles to determine onset of muscle activation prior to landing. For each participant, onset timing was taken as the average result for each muscle and limb across the 3 DVJ trials. Side-to-side comparisons within each participant were performed with the Wilcoxon signed rank test. Injured limbs were compared with the average of both limbs from controls using the Mann-Whitney U-test (α level=0.05). The results are expressed as medians with corresponding ranges in milliseconds (median [range] ms).
Results
No significant side-to-side differences could be found for any of the analysed muscles, neither in patients after ACLR, nor in the control group (p-value 0.200-0.960). When comparing the activity onset of the muscles from the ACLR limb to those of controls, respectively, we found no significant differences in MH: 77 [122] vs. 84 [77] ms, p=0.705; LH: 68 [60] vs. 81 [67] ms, p=0.650; VM: 62 [66] vs. 48 [47] ms, p=0.151; or VL: 50 [54] vs. 47 [36] ms, p=0.567.
Discussion
Based on these preliminary findings, patients with ACLR do not present any muscle activation deficits 9 months after rehabilitation when landing from a standardised DVJ. Given the small sample size, these results need to be verified on a larger cohort of patients and control participants. Furthermore, muscle activity onset should be investigated during more challenging (e.g. unilateral) landing tasks.

SURFACE INSTABILITY DOES NOT ADVERSELY AFFECT JUMPING PERFORMANCE: A MULTI-VARIABLE BIOMECHANICAL INVESTIGATION

POLLITT, L., HANLEY, B., BISSAS, A.

LEEDS BECKETT UNIVERSITY

Introduction
Currently, despite the widespread practical use of surface instability training, little is known about its long-term effects, or about the effect it has on stable surface performance once its demands have been removed. The purpose of this study was to conduct a multi-variable

biomechanical evaluation of the effects of adaptation to progressive drop jump (DJ) training conducted with varying levels of landing surface stability.
Methodology
42 physically active males were exposed to 8 weeks of DJ training using increasing drop heights (i.e., 0.2 m to 1.0 m) onto Mini-Trampoline, BOSU, Stable, or Mix (BOSU & Stable) landing surfaces. A Control group was also included. Pre and post-testing (DJ1.0m, DJ0.6m, DJ0.2m and CMJ) was conducted on a stable surface where kinetic, kinematic, and EMG data were collected. Additional to independent analyses of these systems, muscle moment-power, work-energy and mechanical stiffness data were also constructed to provide an insight into the internal mechanisms of training adaptions. The multi-variable approach yielded a vast array of related variables. For example, dissection of the force-time curve into 66 variables and EMG analysis of specific 50ms windows including identification of the short, medium and long latency reflex responses.
Results
The most important finding was that exposure to landing surface instability did not adversely affect muscle activation, mechanical work and stiffness or energy contributions across joints. Only select changes in neural and mechanical variables reached statistical significance. Improvements in reactive strength index for the surface instability groups at DJ1.0m (18-37%), DJ0.6m (14-28%), DJ0.2m (16-43%), were similar to the Stable group (25, 31 & 21%). Significant improvements in comparison to the Control group ($p<0.05$) were found for the BOSU and Stable groups at each drop height.
Discussion
The absence of any adverse effects in neuromuscular or mechanical variables following surface instability training provides a new insight into the ability of the human body to adapt performance while learning new movement patterns. Essentially, the inclusion of instability with DJ training is as effective as stable landing surface conditions. The findings also suggest that when adaptations are made to the imposed demands, the adverse effects associated with surface instability have been overstated and that the principle of training specificity is not violated. Furthermore, incorporating surface instability may be beneficial to the principle of variability and as an independent consideration within an athletic training cycle, where it could reduce loading demands or be used in combination with skill acquisition, while maintaining levels of performance enhancement similar to those provided by stable conditions.

A BIOMECHANICAL COMPARISON OF CMJ PERFORMANCE FOLLOWING SHORT-TERM TRADITIONAL AND DAILY-UNDULATED LOADED VERTICAL JUMP TRAINING IN AMATEUR ATHLETES

PELZER, T., ULLRICH, B., PFEIFFER, M.

JOHANNES GUTENBERG UNIVERSITY, MAINZ

Introduction
Traditional (TP) and daily-undulating (DUP) periodization models are frequently discussed for single or multi-joint strength-training programs. Biomechanical key variables such as maximal power output during ballistic movements (e.g vertical jumping) are major physical components in many sports (Morin et al., 2015) but were rarely addressed in the current discussion on training periodization. Therefore, this work analyzed the effects of TP versus DUP following short-term loaded jump training on biomechanical countermovement (CMJ) variables in amateur athletes.
Methods
20 amateur athletes (age: 24.2 ± 2.6 years, height: 175.6 ± 7.1 cm, body mass: 71.5 ± 7.7 kg) were divided into a TP (n=10) and DUP (n=10) training group. Both groups performed 6 weeks of loaded vertical jump training with 3 sessions per week. For the LP-group, training intensities (0, 15% and 30% additional load of individual body mass) were linearly increased every two weeks starting with unloaded jumping and continued by two weeks with 15% and two weeks with 30% additional load. Respectively, equal intensities (0%, 15%, 30%) were applied to the DUP-group, changing every training session within a week over the course of the study. To detect possible pre-to-post outcome differences, maximal center of mass (COM) -height, -take-off velocity, -power and -impulse were analyzed for both periodization models under seven different loading conditions (0-30% of body mass) by 2-factor ANOVA (time * periodization model) with repeated measures. Hedges g effect sizes and 95% confidence intervals were calculated for all major outcomes.
Results
Significant ($p < 0.05$) temporal changes occurred for maximal COM-height (TP: 2-7%, g: 0.13-0.31; DUP: 8-11%, g: 0.14-0.75), -take-off velocity (TP: 1-6%, g: 0.12-0.50; DUP: 3-7%, g: 0.17-0.49), -power (TP: 3-5%, g: 0.20-0.46; DUP: 6-9%, g: 0.21-0.39) and -impulse (TP: 2-4%, g: 0.25-0.44; DUP: 3-8%, g: 0.15-0.51). No significant periodization effects occurred for any study outcome.
Discussion
Our results statistically showed TP and DUP equally adepted to enhance biomechanical key variables such as COM-height, -velocity, -power and -impulse following 6-weeks of loaded vertical jumping. Notably, higher effect sizes and confidence intervals for the majority of DUP outcome variables might indicate a superiority for this periodization model. Our results support previous work stating that loaded vertical jumping effectively enhances the lower-extremity power-load relationship. Coaches are recommended to use a range of additional loads if aiming to increase performance during explosive multi-joint tasks such as countermovement jumping.
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SEX AND MATURATION DIFFERENCES DURING THE TUCK JUMP ASSESSMENT IN YOUNG ATHLETES

FORT VANMEERHAEGHE, A.2, BENET, A., MIRADA-CASALS, S., VICENS-BORDAS, J.1, FONT-LLADÓ, R., PRATS-PUIG, A., MONTALVO, A.

FPCEE BLANQUERNA / SCHOOL OF HEALTH AND SPORT SCIENCES (EUSES)

Introduction
Rapid musculoskeletal changes experienced by females throughout the adolescent growth spurt are associated with impairments in lower extremity landing technique (DiStefano et al., 2015). Typically, studies utilize 3-dimensional motion capture to analyze landing technique; however, simpler tools, such as the Tuck Jump Assessment (TJA), exist (Herrington, Myer, & Munro, 2013). It is unknown if this tool is sensitive to differences between males and females or to changes from maturation. Therefore, the purpose of this study was to investigate whether plyometric technique using the TJA differed by sex and maturation.
Methods

A total of 164 youth team athletes (73 males, 92 females) between the ages of 8–18 were included in this study. Each participant was evaluated during a repetitive plyometric task (TJA). This test is a reliable clinical tool that consists of continuous maximal height tuck jumps for ten seconds. It is scored with ten quantitative items (e.g. valgus at landing) associated with neuromuscular imbalances related to ACL injury.
Results
Only valgus at landing had a significant sex*maturation interaction. For the main effect of sex, females had significantly greater knee valgus at landing and fatigue compared to males. For the main effect of maturation, athletes significantly improved TJA scores with increasing maturation stage for most items.
Discussion
Both males and females demonstrated a decrease in plyometric technique errors with maturation except with valgus at landing. In this case, females didn't improve performance at later stages of maturation. Additionally, females demonstrated more fatigue and valgus at landing than males. This finding is of particular relevance because valgus at landing and fatigue are two of the most commonly recorded injury mechanisms reported for non-contact ACL in situational sports (Hewett, Ford, Hoogenboom, & Myer, 2010).
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Contact
afortvan@gmail.com

Oral presentations

OP-BN17 Methods in muscle and tendon biomechanics

EFFECTS OF STATIC STRETCHING, DYNAMIC STRETCHING AND SUBMAXIMAL ISOMETRIC CONTRACTIONS ON MECHANICAL PROPERTIES OF PLANTAR FLEXOR MUSCLES

OPPLERT, J., BABAULT, N.
INSERM U1093 COGNITION ACTION ET PLASTICITÉ SENSORIMOTRICE

Introduction
There are strong evidences that static stretching (SS), traditionally used in warm-up, may impair maximal voluntary strength or muscle power. Recent studies have recommended using dynamic stretching (DS) as part of a warm-up. Indeed, it has been suggested that DS-induced effects may favour force and mechanical muscle properties as a result of the associated submaximal voluntary muscle activation. Therefore, this study aimed to test the hypothesis that the likely positive effects of DS may be mainly due to the associated contractions.
Methods
Eleven active males randomly performed two sets of 20-s of the following interventions: i) control (CON), ii) SS, iii) DS and iv) submaximal isometric contractions (SIC). Attention was paid to perform SIC with the same muscular activation as with DS. Plantar flexor muscles were considered and all sessions were conducted on an isokinetic dynamometer. Peak twitch torque (PTT), rate of force development (RFD) and fascicles stiffness index were measured before and immediately after each intervention. PTT and RFD were measured from the mechanical responses elicited at rest by doublet supramaximal electrical stimulation of the posterior tibial nerve.
Results
Fascicles stiffness index was evaluated via ultrasonography. Accordingly, fascicle length variations were measured during the five last degrees of a maximal dorsiflexion and were expressed with respect to plantar flexor passive torque. Significant PTT and RFD increases were obtained after SIC (+6.18 ± 1.67% and +8.47 ± 2.59% respectively) while no change was observed after SS and DS. Fascicles stiffness index was significantly decreased after SS and DS (-28.51 ± 7.15% and -29.43 ± 6.94% respectively) but it was not affected by SIC. No difference was observed between SS and DS for PTT, RFD and fascicle stiffness index.
Discussion
The present results did not permit to observe any positive effects of DS. DS similarly affected the mechanical properties than the other stretching modality (SS). We concluded that the submaximal muscle activation during DS was insufficient to counteract any stretching effects. Performing submaximal voluntary contractions alone would be more favourable as part of warm-up.

LOADING RATE AND CONTRACTION TYPE EFFECTS ON THE HUMAN ACHILLES TENDON FORCE-ELONGATION RELATIONSHIP

MCCRUM, C.1,2, OBERLÄNDER, K.D.2,3, EPRO, G.2,4, KRAUSS, P.2, REEVES, N.D.5, KARAMANIDIS, K.4
MAASTRICHT UNIVERSITY

Introduction
While it is accepted that tendons are viscoelastic, the loading rate of contractions is often not strictly controlled when assessing human tendon mechanical properties in vivo. Given the potential benefits of sustained constant load isometric contractions for in vivo tendon property assessment, we aimed to determine if sustained submaximal isometric plantarflexion contractions result in a similar force-elongation relationship and stiffness of the Achilles tendon (AT) to other loading methods.
Methods
The AT mechanical properties (elongation and stiffness) of the dominant leg in ten male adults (26.5±5.5y) were assessed during isometric plantarflexion contractions by integrating dynamometry and ultrasonography (Aloka α7, Tokyo, Japan). Measurements were taken on two consecutive days and the results from all participants on day one and seven participants on day two (three excluded due to measurement problems) were pooled for the analysis. Maximum voluntary contractions (MVC; high loading rate), ramp maximum force con-

tractions with three seconds loading (RAMP; lower loading rate), and sustained contractions (held for three seconds) at forces of 25%, 50% and 80% of the maximal tendon force with the lower loading rate (SUS) were conducted.
Results
A two way repeated measures ANOVA with method and tendon force level as factors revealed a significant method ($P<0.001$) effect on tendon elongation. Post hoc tests with Bonferroni corrections revealed significantly greater tendon elongation in SUS compared with MVC ($P=0.001$) and RAMP ($P=0.002$), but no differences in tendon elongation between MVC and RAMP ($P=0.077$). A one way ANOVA with method as a factor did not reveal a significant method effect on tendon stiffness ($P=0.079$; MVC: 653.6±220.9 N/mm; RAMP: 694.8±190.3 N/mm; SUS: 564.2±148.1 N/mm).
Discussion
Sustained plantar flexion contractions appear to lead to an increased AT elongation for a given force, presumably due to the reduced influence of the loading rate on the viscoelastic behavior of the tendon during the sustained contractions. However, AT stiffness was not significantly different between methods, suggesting that the differences in the rate of elongation occurred prior to the linear region of the force elongation relationship. Sustained isometric contractions appear to be appropriate for assessing AT stiffness in vivo, although potential differences in tendon elongation should be considered when comparing results with other methods.
Contact
chris.mccrum@maastrichtuniversity.nl
1: Maastricht University, The Netherlands. 2: German Sport University Cologne, Germany. 3: University of Applied Science Fresenius, Germany. 4: London South Bank University, U.K. 5: Manchester Metropolitan University, U.K.

DIFFERENT PATELLA MOMENT ARM FUNCTIONS ALTER THE FORCE PREDICTIONS AND SHAPE OF THE VASTUS LATERALIS MUSCLE FORCE-LENGTH RELATIONSHIP

BAKENECKER, P., RAIERI, B., HAHN, D.

RUHR-UNIVERSITÄT BOCHUM

Introduction
Because of the difficulties of measuring muscle forces non-invasively in humans, in vivo muscle forces are often estimated by dividing the maximum voluntary net torque measured at a joint by the estimated angle-specific muscle-tendon moment arm (MA), after accounting for the approximate torque contribution of the muscle of interest. However, muscle-tendon MAs are known to vary between genders and individuals and are affected by the level of contraction. Despite these limitations, different generic mean patella tendon moment arm data are often used to estimate the vastus lateralis (VL) muscle forces, which may alter peak force predictions and the optimal knee angles for peak force production. Therefore, the aim of this study was to examine the influence of different moment arm functions on VL force predictions at various knee angles.
Methods
Participants (n=3) were seated on an isokinetic dynamometer with a hip angle of 70° and performed maximum voluntary isometric knee extensions at seven different knee angles ranging from 55° to 105° (10° increments). Net knee joint torques were recorded at 1000 Hz. To estimate VL muscle force, the peak knee extension torque at each joint angle was multiplied by the proportion of force associated with VL based on the physiological cross-sectional area (PCSA) of VL relative to the quadriceps group (34%), and then divided by the angle-specific MA of the patella tendon from Nissel et al. (1985), Herzog et al. (1993) or Buford et al. (1997).
Results
Preliminary results showed that there were small differences in VL muscle force predictions using the mean MA data from Nissel et al. (1985) and Herzog et al. (1993) with a mean peak difference of 1.75±0.1% at a knee angle of 70° or 60°. This was in contrast to the force predictions estimated with moment arm data from Buford et al. (1997), where the mean peak difference was 32.1±1.1% to Herzog et al. (1993) and 32.5±2.2% to Nissel et al. (1997). Peak VL muscle force was 3882.1±335.5N, 2634.9±214.4N and 2617.9±206.9N when using the MA data from Buford et al. (1997), Herzog et al. (1993) and Nissel et al. (1985), respectively.
Discussion
Based on the PCSA of the VL muscle it is expected that its maximum force-generating capacity is approximately 2052 ± 125 N. Therefore, it is unlikely that the peak VL force determined from the MA data of Buford et al. (1997) at a knee angle of 70° or 60° is incorrect. The larger MAs from this study compared with the other two studies are likely due to a tendon excursion method, whereas Nissel et al. (1985) and Herzog et al. (1993) defined the patella tendon MA as shortest distance from the knee joint centre to the line of action of the quadriceps muscles. It is reassuring that this latter definition of the patella tendon MA gave peak muscle force predictions that fall within the peak force estimates based on the muscle's PCSA. From this preliminary data, it appears that moment arm functions from Herzog et al. (1993) or Nissel et al. (1985) can be used to estimate VL muscle forces for the knee joint angles tested here.

SHOULD WE USE THE SLACK TEST TO MEASURE MAXIMAL SHORTENING VELOCITY OF HUMAN MUSCLE FASCICLES?

HAGER, R.1, DOREL, S.2, NORDEZ, A.2, RABITA, G.1, HAURAIX, H.2, DUCHATEAU, J.3, GUILHEM, G.1

1: FRENCH INSTITUTE OF SPORT (INSEP), RESEARCH DEPARTMENT, LABORATORY SPORT, EXPERTISE AND PERFORMANCE (EA 7370), PARIS, FRANCE

Introduction
Maximal shortening velocity is a fundamental muscle property (Hill, 1938). Implemented by Sasaki and Ishii (2005), the application of extremely high shortening while muscle contracts isometrically (i.e. slack test) would be a more promising method than the ballistic test for evaluating this capacity. The slack test procedure assumes that the assessment of maximal angular velocity reflects the muscular contribution to velocity-generating capacity although it does not measure muscle shortening velocity. The present study aimed to directly assess gastrocnemius medialis (GM) fascicle shortening velocity (VF) during the slack-test. In addition, VF obtained during the slack test was compared to unloaded ballistic condition (Hauraix et al., 2015).
Methods
Muscle fascicle behaviour was recorded on GM muscle of 25 participants using ultrafast ultrasound (Hauraix et al., 2015) during slack tests and ballistic test performed with a starting position set at -15° in dorsiflexion. Slack test was applied at various amplitudes (30, 35, 40, 45, 50°) and initial torque levels (5, 10, 20, 40 and 60% of maximal voluntary (MVC) isometric torque) on a mechatronic ergometer (Eracles-Technology, Compiègne, France). Peak VF, tendinous tissues shortening velocity (VTT) and mean articular velocity were calculated in each test.
Results

Maximal VF were higher in slack test at 5% torque level (42.4±12.9 cm.s-1) than in ballistic (36.3±8.7 cm.s-1), and minimal at 60% (29.3±13.2 cm.s-1) indicating that VF decreases with the increase in torque (P<0.001). Inversely VTT showed a significant effect of torque level (P<0.001) and amplitude (P<0.001) indicating that VTT increases with torque. No correlation was found between slack test and ballistic test for maximal VF or maximal articular velocity.
Discussion
The present study demonstrates that using the slack test in vivo appears debatable to reliably appraise maximal muscle shortening velocity. This finding could partly originate from the contribution of tendinous tissues, which is very difficult to isolate at the initial contraction level increases.
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Oral presentations

OP-SH15 Mental fatigue and recovery

MENTAL FATIGUE IMPAIRS SPORT-SPECIFIC REACTION TIME.

ROELANDS, B.1, VAN CUTSEM, J.1,2, DE PAUW, K.1, MARCORA, S.2, MEEUSEN, R.1
1 VRIJE UNIVERSITEIT BRUSSEL, BELGIUM 2 UNIVERSITY OF KENT AT MEDWAY, UK

Introduction
Recent research has reported that mental fatigue impairs manual dexterity and slip anticipation. Therefore we sought to examine the effect of a mentally fatiguing task on motor-reaction time (M-RT) performance.
Methods
A M-RT task was developed with Fitlight-hardware and -software in order to evaluate the effect of mental fatigue on simple and response inhibition stimuli and on stimuli in the central and peripheral visual field. In the M-RT task, pads 1 up to 7 would aluminate randomly one after the other in the color red, green, yellow or blue. If a pad lighted up in red, green or yellow participants had to react forward (simple stimuli). If a pad lighted up in blue, participants had to put out the pad behind them (8; response inhibition stimuli). Eleven untrained healthy subjects (age: 25 ± 4y; 6 female, 5 male) performed two experimental trials in a randomized crossover order. Participants first completed a baseline M-RT task (~6min30sec), followed by a Flanker task. Next they performed either a 90min mentally fatiguing task (Stroop task; MF) or watched a 90min documentary (CON). Immediately thereafter again the Flanker task and the M-RT task were completed. Accuracy (ACC) and reaction time (RT) were followed up in all tasks but the documentary. In addition physiological and psychological measures were assessed during the protocol. Repeated measures ANOVA's were used to analyze the data.
Results
ACC on both the Stroop (p=0.021) and the Flanker task (~3%; p=0.048) decreased over time in MF. Participants got faster over time on the Stroop task in MF (p≤0.004). RT on the Flanker task did not change over time in both MF and CON. Subjectively, higher (p=0.001) mental fatigue was perceived in MF compared to CON. Concerning the M-RT-performance, no effects were observed for the simple stimuli. For the response inhibition-stimuli, only in MF the participants became significantly slower in time (~7.5%; p=0.007).
Discussion and Conclusion
Mental fatigue negatively affects sport-specific response inhibition-RT. Therefore, besides endurance capacity, sport-specific cognition also appears to be impaired by mental fatigue. The impairment in RT was independent from the visual-field position of the stimulus and was not perceived by the participants.

MONITORING SLEEP OF THE GERMAN JUNIOR ROWING TEAM DURING THE WORLD ROWING JUNIOR CHAMPIONSHIPS FOLLOWING WESTWARD TRAVEL

KÖLLING, S., KELLMANN, M.
RUHR UNIVERSITY BOCHUM

Introduction
In elite sports, optimal sleep is crucial for recovery and readiness for upcoming events, while it is reported to be impaired before competitions (Erlacher et al., 2011). Transmeridian travel prior to international competitions might be associated with jet-lag and, thus, an impeding factor to performance (Kölling et al., 2016). There is a paucity of research among elite athletes regarding sleep during world championships as well as the effect of time-zone transitions preceding these events. This study aimed at monitoring sleep parameters of the German Junior National Rowing Team before and during the World Rowing Junior Championships (WRJC) in Rio de Janeiro, Brazil.
Methods
Seventeen members of the team (9 males, 17.6±0.7y, 184.5±11.3cm, 82.4±13.6kg) were monitored via actigraphy (SenseWear Armband™, Bodymedia, USA) during the training camp in Germany before travelling to Rio de Janeiro (GER, 3 nights) as well as before WRJC (3 nights, pre-WRJC) and during WRJC (3 nights). The journey took >24h and sleep was not monitored during the overnight flight (11h). The westward travel caused a time delay of 5h. To examine the change in sleep parameters, 3 nights of each episode were averaged and analysed via repeated measures ANOVA.
Results
During the flight, self-reported sleep was 0 to 520 min (M=252.9±162.3). Upon arrival in the morning, 9 rowers reported no sleep, while 5 slept 30 to 105 min. Pre-WRJC (21:37±0:24h) and during WRJC (21:32±0:24h), bedtime reduced compared to GER (22:31±0:14h, p<.001, ηp^2=0.75), while wake after sleep-onset (WASO) increased (pre-WRJC 73.5±50.0 vs. GER 49.8±38.3 & WRJC 64.8±46min, p<.01, ηp^2=0.28). Total sleep time (TST) increased pre- and during WRJC (397.0±65.8, 388.9±58.3 vs. GER 364.1±56.8min, p<.05, ηp^2=0.22). Sleep-onset latency (SOL) showed a reduced tendency pre-WRJC (7.5±6.6 vs. GER 18.5±17.8 & WRJC 12.2±9.2min, p<.05, ηp^2=0.22). Awakenings during WRJC slightly increased (14.0±4.4 vs. GER 11±3.3 & pre-WRJC 12.8±3times, p<.05, ηp^2=0.2).
Discussion

As hypothesized, early bedtimes, reduced SOL and increased WASO pre-WRJC indicate signs of jet-lag due to forced phase-delay, while extended TST suggests increased need for recovery and alleviate sleep debt. The schedule should offer sufficient time to adapt and recover from strenuous journeys and dissuade from late-night activities. More frequent awakenings during WRJC might indicate slightly disturbed sleep caused by the demands of the event. However, overall performance of the team was apparently not impaired as indicated by 11 of 13 top 3 placings.

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Contact
Sarah.Koelling@rub.de

THE EFFECT OF STRENUOUS CONCURRENT EXERCISE ON COGNITION, MOOD AND RATINGS OF ENERGY AND FATIGUE

BROWNE, S., EDDENS, L., HOWATSON, G., HASKELL-RAMSAY, C.

NORTHUMBRIA UNIVERSITY

Introduction
Strenuous exercise has been demonstrated to have detrimental effects on cognitive performance in untrained individuals. Trained individuals however are better able to cope with greater physical loads which can alleviate the negative effects on cognition. Previously research has typically assessed cognitive performance following isolated aerobic or resistance exercise, despite many training and sporting paradigms frequently performing combined or concurrent exercise. The aim of this study was to investigate the effect of concurrent exercise on cognitive performance in trained individuals.
Methods
In a repeated-measures crossover design, twelve well-trained males (26 ± 5 years old; height 178.9 ± 8.2 cm; mass 73.9 ± 11.1 kg; VO2peak 62.1 ± 5.6 mL·kg-1·min-1) completed a strenuous bout of concurrent aerobic and resistance exercise or a seated control. The exercise bout consisted of a high-intensity stochastic cycling protocol followed by 100 drop-jumps. Prior to and following the strenuous exercise or equivalent control duration, a selection of cognitive tests including simple reaction time, four-choice reaction time, Corsi blocks and a colour-word Stroop task were completed in addition to visual analogue scales assessing mood, energy and fatigue. To assess the effect of the exercise bout on functional performance, power and strength were assessed via a maximal voluntary contraction (MVC) and countermovement jump (CMJ) pre and post each condition. Repeated-measures ANOVAs were conducted with pair-wise comparisons where necessary (α=0.05).
Results
Stroop task congruent reaction time was slower following strenuous exercise (+9%) alongside a reduction in feelings of alertness (-17%) and contentedness (-8%). In addition, feelings of physical (-20%) and mental (-38%) energy were reduced whilst ratings of physical (+131%) and mental (+57 %) fatigue increased (all $P<0.05$). No changes were observed in the control condition. As expected, the prolonged strenuous exercise resulted in a reduction of both MVC (-15%) and CMJ (-8%).
Discussion
Prolonged strenuous concurrent exercise had a detrimental effect on speed of performance in trained individuals during a complex task requiring higher-order cognition. Furthermore, mood was impaired alongside large increases in ratings of mental and physical fatigue. These results highlight that despite being well-trained and accustomed to high loads, prolonged strenuous exercise impaired cognitive function. When exposed to extended periods under high physical loads, reductions in speed of processing and decision-making may expose individuals to greater risk of injury and thus strategies should be investigated to aid in alleviating these negative effects.

Contact
browne.sarah@northumbria.ac.uk

INFLUENCE OF MATCH DEMANDS ON RECOVERY/STRESS STATES IN ELITE YOUTH FOOTBALL PLAYERS

PELKA, M., SCHNEIDER, P., KELLMANN, M.

RUHR UNIVERSITY BOCHUM

Introduction
Intensive games, travelling, and short regeneration phases add to high physical and psychological pressures in football (Laux et al., 2015). Professional teams acknowledge this fact and focus on physiological recovery after competition. However, as recovery and stress are multidimensional processes (Kellmann, 2010), focus should be on mental and emotional states after competition as well. Changes in affective states and general well-being have already been described as being sensitive to weekly training manipulations (Gastin et al., 2013). The aim of this study was to examine whether matches affect physical, mental, and emotional states as well.
Methods
A total of 25 Under 19 (U19) football players (Mage: 17.5 ± .5 years, MBMI: 22.67 ± 1.57) of an U19 Junioren Bundesliga team participated over the entire 6-month assessment period. The players completed the Short Recovery and Stress Scale (SRSS, Kellmann et al., 2016) twice a week on Monday and Friday mornings between 7 and 9am. To allow for a sophisticated analysis, the team was divided in those who played more than 60 min in a match and those who played less than 60 min.
Results
Wilcoxon signed rank tests revealed significant main effects for changes from Monday to Friday ratings in players who played more than 60 min (group 1) and less than 60 min (group 2). However, different items were relevant for the two subgroups groups. For example, group 1 was more stressed after matches, i.e., Muscular Stress ($Z = -3.06$, $p = .002$, $r = -.88$) and Overall Stress ($Z = -3.06$, $p = .002$, $r = -.88$). Taking group 2 into account yielded a different pattern. This group experienced a higher Negative Emotional State ($Z = -2.35$, $p = .019$, $r = -.68$) and Lack of Activation ($Z = -2.71$, $p = .007$, $r = -.75$) when comparing Mondays' and Fridays' recovery scores.
Conclusion
The present study examined the impact of matches on subjective ratings of physical, mental, and emotional recovery/stress states using the SRSS. Results revealed that matches affect those who played more than 60 min differently compared to those who played less than 60 min. This was the case not only for the physical recovery/stress rating but also for mental, emotional and overall self-reports. Therefore, to be holistic and potentially more effective, recovery after matches should adopt a multidimensional approach.
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THE EFFECT OF RECOVERY-STRESS IMBALANCE ON EMOTIONAL EXHAUSTION IN GERMAN COACHES

SCHAFFRAN, P.1, ALTFELD, S.1, ZEPP, C.2, KLEINERT, J.2, KELLMANN, M.1,3

1: RUHR-UNIVERSITY BOCHUM (GERMANY), 2: GERMAN SPORTS UNIVERSITY COLOGNE (GERMANY), 3: THE UNIVERSITY OF QUEENSLAND (AUSTRALIA)

Introduction
Coaches have to deal with a multifarious range of demands. For example, they have to cope with inconvenient work hours, high workload, traveling, short contracts, job insecurity, role conflicts, and media pressure (Olusoga et al., 2010). In this complex, dynamic, and turbulent environment, coaches have to manage their own physical and emotional state using self-regulation strategies and personal recovery to perform at their optimal level. A growing imbalance of coaches' stress and recovery could lead to emotional exhaustion (Raedeke, 2004), which is widely accepted as the key symptom of burnout. The aim of this study was twofold. First, to examine the prevalence of emotional exhaustion in German coaches. Second, to investigate the impact of recovery and stress on emotional exhaustion.
Methods
A total of 233 coaches (M = 37.3 years, s = 13.6 years, 72.5% male) of various sports and performance levels participated and responded to an online survey. Emotional exhaustion was measured using the coach-specific German adaptation of the Maslach Burnout Inventory (Maslach & Jackson, 1996), whereas recovery and stress were measured using the Recovery-Stress Questionnaire for Coaches (RESTQ-Coach; Kellmann, Kallus & Altfeld, 2016).
Results
The results showed mean scores of 1.38 (s = 0.79) for Emotional Exhaustion, suggesting low to medium levels of burnout. However, according to the standard values of Maslach and Jackson (1996) 12.9% of the coaches can be categorized as highly emotionally exhausted. Multiple regression analysis demonstrated a significant impact of the RESTQ-Coach dimensions Overall Stress ($\beta = 0.29$, $p < .001$), Overall Recovery ($\beta = -0.15$, $p < .05$), and Coach-Specific Stress ($\beta = 0.31$, $p < .001$) on Emotional Exhaustion.
Discussion
The results suggest, that every eighth German coach is affected by burnout. Moreover, monitoring the recovery-stress balance of sport coaches over the course of a competitive season could help identify coaches' burnout risk.
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Contact
Paul.Schaffran@rub.de

Oral presentations

OP-PM72 Tools and testing in sports

ESTIMATION OF LACTATE THRESHOLD USING MACHINE LEARNING TECHNIQUES

ETXEGARAI, U., PORTILLO, E., CABANES, I., IRAZUSTA, J.

UNIVERSITY OF THE BASQUE COUNTRY UPV/EHU

Introduction
Lactate threshold is an important parameter to consider when planning the season training (Billat, 2003). However, its calculation requires costly equipment usually only available in specialized centers. This restricts its applicability to few athletes, especially if frequent monitoring is sought. Therefore, the aim of this study is to provide a non-invasive and easily accessible lactate threshold estimation method using machine learning (ML) techniques.
Methods
130 endurance sports athletes participating in several disciplines were recruited to perform an incremental running test and asses their lactate threshold. In addition, heart rate-derived variables were also gathered. ML models were then trained using different combinations of these variables as inputs and the lactate as output. To do so, the database was split into two data sets, a training set to fit the ML model and a test set to validate it with new population. Among the several models created the best one was selected according to its correlation with the experimentally calculated lactate threshold.
Results
The Pearson's correlation coefficients between the estimated lactate thresholds and the experimentally measured lactate thresholds for the training and test sets were r=0,93 and r=0,81 respectively and r=0,89 in total. This represents that the accuracy of the model is high not only with the athletes used to fit the model but also with new athletes, meaning that the generalization power of the model is high.
Discussion
In ML applications, assessing the generalization capabilities of the models is essential for its applicability to real world situations. Our results show that in this work a good trade-off between accuracy and generalization is obtained. To the best of our knowledge, among the few previous works done on this field, only the one proposed by (Erdogan et al., 2009) obtained a comparable accuracy to the model presented here. However, authors observed that more cases from heterogeneous groups were needed for better generalization and the actual generalization capabilities of the model were not addressed making it difficult to apply it in real situations. Moreover, the model

proposed by Erdogan et al. estimated the heart rate at OBLA point instead of the individual lactate threshold calculated with Dmax method, which is the most recommended methodology nowadays (Santos-Concejero et al., 2014) and the one estimated in this work. Therefore, this study presents a novel non invasive and applicable method to assess the lactate threshold of endurance athletes.

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Contact
urtats.etxegarai@ehu.eus

A FUTURE APPLICATION FOR WEARABLES IN SPORT. ASSESSMENT IN PHYSICAL ACTIVITY USING OXYGEN SATURATION DETERMINATION FOR PREDICTING VENTILATORY AND LACTATE THRESHOLD

MARTIN-ESCUDERO, P., GIANNETTI, R., MIGUEL-TOBAL, F., LÓPEZ-SILVA, S.M., DOTOR-CASTILLA, M.L., SANCHEZ-MIRALLES, A., GALINDO-CANALES, M.

UNIVERSITY COMPLUTENSE OF MADRID; CNM-CSIC;ICAI COMILLAS MADRID

Introduction
The objective of this study is to demonstrate a high tempory correlation between changes in the slope of blood oxygen saturation (SpO2), ventilatory thresholds (aerobic and anaerobic) and lactic thresholds during maximum bicycle ergometer stress tests.
Methods
Measurements were made with a pulse oximeter, an ergospirometry system and lactic acid measurement device, in a population of 19 healthy male Caucasian volunteer athletes, aged 35.9 SD 8.44 (years); height 176.13 (cm) SD 6.88 and weight 76.22 (Kg) SD 8.44 .
Results
The results indicate a correlation between the time where oxygen desaturation (Sp02) occurs and the time where VT2 occurs, along with the second sharp increase of lactic acid. Comparing data of the rate of saturation drop and the maximum increase in lactate thus, it seems possible to predict the increase in lactate in at least 70% of the athletes, with an accuracy of ± 2 mmol / L.
Discussion
These results suggest that the continuous determination of SpO2 by pulse oximetry is a valid noninvasive method of indirect determination of metabolic transition points during the training. Is useful and would allow to evaluate the athlete physical performance being an useful tool in the control and manage training, control of heart rate in healthy individuals through training applications, monitoring for amateurs athletes, tracing in high-altitude sports (himalayism) and management in exercise prescription.

RELIABILITY AND VALIDITY OF FIELD-BASED STRENGTH TESTS FOR ELDERLY TO BE USED IN YOUNGER KOSOVAN ADULTS

BOSHNJAKU, A.1, BAHTIRI, A.2, FEKA, K.1, KRASNIQI, E.3, TSCHAN, H.1, WESSNER, B.1

1: UNIVERSITY OF VIENNA, 2: UNIVERSI COLLEGE, 3: MEDICAL UNIVERSITY OF TIRANA 4: UGJFA (GJAKOVE, KOSOVO)

Introduction
The senior fitness test developed by Rikli and Jones (1999) consists of biceps curl (BC), chair stand (CS), 6-minute walk, chair sit and reach, back scratch and timed-up and go tests [1]. In elderly, these tests have been shown to be reliable (ICCs ranging from 0.80 to 0.99) and valid (r=0.71-0.84). For epidemiological studies observing physical fitness throughout the life span, there is a need to choose tests with similar reliability in young and old adults. Therefore, this study aimed to compare test-retest reliability and validity of upper and lower body strength tests between young and old Kosovan adults.
Methods
Sixty-eight elderly (43f and 25m, age: 68.7±8.1 y) and 57 young subjects (26f, 31m, age: 22.7±3.7 y) participated in two identical test sessions 2-3 weeks apart. Thirty second CS and 30s BC tests were performed according to the senior fitness test manual [1]. Isokinetic peak torque (knee extension and flexion) was assessed on a Biodex dynamometer and isometric handgrip strength was measured on a Jamar handgrip dynamometer. For statistical analysis ICC, change in mean, typical error of measurement, and Pearson correlation were used to assess test-retest reliability and validity [2].
Results
There was a significant test-retest difference in older adults [CS: 1.3±1.7 reps, BC: 0.7±2.2 reps, $p<0.01$], but not in younger ones [CS: 0.5±1.9 reps, BC: 0.1±2.3 reps, $p>0.05$]. For both tests the typical error of measurement (95%CI) was similar in young [CS: 1.3 (1.1-1.7) reps, BC: 1.6 (1.4-2.0) reps] and old subjects [CS: 1.2 (1.0-1.4) reps, BC: 1.6 (1.4-1.9) reps]. ICCs (95% CI) were slightly higher in younger [CS: 0.95(0.91 – 0.97), BC: 0.94 (0.90 – 0.97)] as compared to older participants [CS: 0.86 (0.79 – 0.91), BC: 0.79 (0.68 – 0.87)]. CS correlated significantly with knee extension and flexion knee torques at 60 and 120°/s as did BC with handgrip strength (all $p<0.001$), with Pearson correlation coefficients ranging from 0.65 to 0.72 in young and 0.47 to 0.55 in old subjects revealing only moderate correlations between field and laboratory tests.
Discussion
We have shown that the field-based strength tests included in the senior fitness test [1] are at least as reliable and valid in young adults as they are in an older population. Although CS has been evaluated already in the clinical setting [3,4], this is the first study in a healthy young cohort. We conclude that CS and BC tests are suitable to assess strength over a broad range of age groups, but future studies need to evaluate whether these findings hold true also for the other items of the senior fitness test.

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AGE-SPECIFIC ACCELEROMETER CUT-POINTS FOR PHYSICAL ACTIVITY INTNESITY

PARK, S., LEE, M., LEE, H.J.
KOREA INSTITUTE OF SPORTS SCIENCE

Introduction
Regular physical activity (PA) provides health benefits in individuals across ages. Given that PA recommendations for health benefits are intensity specific, it is important to differentiate PA intensities. The Actigraph is the most commonly used accelerometer to objectively measure PA in research. The Actigraph output is quantified as counts-per-minute (CPM) with the cut-points to classify PA intensities as light, moderate and vigorous based on metabolic equivalents (METs); light <3 METs, moderate 3-6 METs, vigorous > 6METs (Freedson et al., 1998). Cut-points differ across accelerometer models (Sasaki et al., 2011) and age ranges (Miller et al., 2010). However, it is a paucity of research to determine specific cut-points for each model and different age groups using the same protocols. Thus, the purposes of this study were 1) to compare activity counts across age groups, 2) to develop the age-specific accelerometer cut-points to classify PA intensities, and 3) to examine the feasibility of the cut-points through activities of daily living.
Methods
The participants (n=293, age 43.96 ± 14.32yr) were divided into different age groups (20-29, 30-39, 40-49, 50-59, ≥60 yr). The participants in the calibration study performed light, moderate and vigorous activities on a treadmill, and the others in the validation study did activities of daily living. All the participants wore the GT3X on the non-dominant hip. The CPM of vertical axis (VT) and vector magnitudes (VM) of the GT3X were analyzed. Receiver operating characteristic (ROC) curve was utilized to determine the cut-points of PA intensities and feasibility for classification accuracy in activity.
Results
There were significant interactions between PA intensities and age groups in activity counts for both VT and VM. The activity counts on VT and VM in the vigorous activities were reduced in the elderly (≥60 yr) from the adults (>60 yr). The VT cut-points for moderate and vigorous intensity were 2098 and 6087 CPM in the adults and were 1840 and 4835 CPM in the elderly, respectively. The VM cut-points for moderate and vigorous activities were 2878 and 6925 CPM in the adults and were 2603 and 5344 CPM in the elderly, respectively. The cut-points feasibility exhibited classification accuracy from good to excellent (AUC of ROC 0.842-0.954).
Discussion
The activity counts were age-specific, especially in vigorous activities. Thus, age-specific cut-points should be applied using accelerometers.
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Contact
saejpark@sports.re.kr

DEVELOPMENT OF TWO ECONOMIC AND SENSITIVE TOOLS TO ASSESS ACUTE RECOVERY AND STRESS IN SPORTS

KELLMANN, M., KÖLLING, S.
RUHR-UNIVERSITÄT BOCHUM

Introduction
In competitive sports, poor regeneration management and an imbalance of (training) stress and adequate recovery can be decisive factors of success. The key is to evaluate the recovery-stress state of athletes individually, monitoring them regularly and comparing the data longitudinally. Since existing questionnaires are either too long, unidimensional or unspecific for continuous use in elite sports, the Acute Recovery and Stress Scale (ARSS) and the Short Recovery and Stress Scale (SRSS) were developed.
Methods
The development of the ARSS involved a multi-stage process beginning with expert ratings to create initial items and constructing the questionnaire following psychometric and statistical guidelines in several studies (Hitzschke et al., 2016). Finally, the ARSS consists of 32 items which are rated on a 7-point scale (0-6) and summarised to 4 recovery and 4 stress scales covering physiological, emotional and mental dimensions. This model was analysed among the target population of 574 elite athletes via Confirmatory Factor Analysis. In a second step, these 8 scales were applied as single items to build the SRSS to provide a more economic version (Hitzschke et al., 2015).
Results
The ARSS scales showed acceptable to good internal consistency (α = .76 to .90) as well as good model fits for both the recovery (RMSEA = .06, CFI = .97, SRMR = .04) and stress factors (RSMSEA = .07, CFI = .96, SRMR = .06). Internal consistency of SRSS recovery (α = .70) and stress (α = .76) was acceptable. Spearman correlations between corresponding ARSS scales and SRSS items ranged between r = .46 to .74.
Discussion
The ARSS and the SRSS are two economic and valid instruments for elite athletes which could show sensitive changes in several regman field and laboratory studies (Kölling et al., 2015; Pelka et al., 2017). As expected, stress scores increased and recovery scores decreased following physical training. The tools can be applied for groups and individuals at the age of 16. Validity for younger athletes needs further investigation.
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11:30 - 12:45

Plenary sessions

PS-PL04 INCLUSION IN SPORT

PROSTHESES AND ORTHOSES – HOW DO THEY EFFECT LOAD MANAGEMENT AND SPORTS PERFORMANCE?

BRÜGGEMANN, G.

GERMAN SPORT UNIVERSITY COLOGNE

People have always thought the human body is ideal and has the most appropriate potential to enhance physical performance in sports. It is not and became evident that when working technology can make an athlete stronger or faster. A prosthetic foot acts like a leaf spring on a vehicle, and allows energy storage and return with a minimum of energy loss the athlete get. Opposite to such minimum energy loss of the prosthetic foot, the ankle joint and foot of able-bodied athletes lose much more energy in fast running or taking off for a jump. A double transtibial amputee spends 35% less time in the air between steps in sprinting, takes 20% less time to swing his legs between steps, has a metabolic cost of running that is 15-20% lower than able-bodied sprinters at the same level of performance. All these factors are in favor to the disabled sprinter. Technology do effect sports performance for the disabled athlete, but enables the disabled human to participate in sports and physical activity. Orthoses are designed to align the skeleton, to reduce the range of motion in secondary planes of motion, to re-distribute the intraarticular load, and to enable the athlete to perform after an injury or to prevent the injury. Technically improved orthoses or extra skeletons will have the potential to reduce the loss of energy in human joints during fast locomotion or repetitive loading. Elective surgical human enhancement is a third attempt to performance enhancement and load management. The healthy athlete undergoes a surgical intervention to increase the physical potential to perform or to optimize the load management. The presentation will review the potential of prostheses and orthoses and we will speculate on future technical development and its impact to performance enhancement and load Management.

THE BUSINESS OF INCLUSIVE SPORT: A PHILOSOPHICAL ANTHROPOLOGY OF UTOPIA

HOWE, P. D.

LOUGHBOROUGH UNIVERSITY

For two generations disability rights advocates have highlighted the need for people with disabilities to be included in society without restriction of any kind. Within the world of sport this principle of inclusion has also been gaining momentum and contemporary national and international sport policy highlight its importance. Today social inclusion and the principles of universal design are lofty goals that are championed by the disability sport industry and they are celebrated for it. However, I will suggest the disability sport industry has both championed inclusion on the one hand and used its rhetoric to feather its own nest on the other. Rather than inclusion I will argue that society needs to celebrate difference within sport. Because of the calling card of inclusion disability discrimination is still seen as insignificant compared to issue of racism and homophobia where large public platforms of awareness are now the norm. This plenary talk highlights how Paralympians and the lives they lead, can be seen as the focus for gathering ethnographic data on the social world. I will critical examine inclusion within sport to highlight how it is being used as a tool to enhance segregation. By examining inclusion and unpacking the rhetoric around it we might realise the dream of 'sport for all' that has long been advocated in sports policies but seldom found in practice.

13:00 - 14:00

Conventional Print Poster

CP-SH01 Physical education

INVESTIGATION OF THE JOB SATISFACTION AND CREATIVITY LEVELS OF PHYSICAL EDUCATION AND SPORTS TEACHERS

TEKIN, M.1, SAVAS, M.S.2

1KARAMANOGLU MEHMETBEY UNIVERSITY SCHOOL OF PHYSICAL EDUCATION AND SPORTS, KARAMAN 70100, TURKEY 2AKSARAY UNIVERSITY SOCIAL SCIENCES INSTITUTE, PHYSICAL EDUCATION AND SPORTS DEPARTMENT, AKSARAY 68000

Introduction
The driving force in the process of transition to information society is knowledgeable people.The teacher has the greatest responsibility for raising this qualified human power.It is important for physical education and sport teachers,who have important duties in mental,physical,social and spiritual development of the students,to have high level of job satisfaction and creativity so that they can work more efficiently.Raising of the students as qualified and successful individuals is closely related to the success of teachers.The aim of this study is to examine the Job Satisfaction and Creativity Levels of Physical Education and Sports Teachers.
Methods
The research group of the consist of 30 male, 22 female, 52 in total Physical Education and Sports Teachers in Karaman province.To achieve the purpose of the research,Minnesota Satisfaction Scale developed by Weiss and et al 1967and adapted to Turkish by Baycan (1985) And Adaptation-Innovation Inventory (KAI)" Originally Developed By Krikton.(1999) were based on and applied to the students that participated in the research In the analysis and assessment of the data,Kolmogorov-Smirnov test,Multiple Linear Regression,And Multivariate Manova Test,was used and significance was taken as $P<0.05$ and in the evaluation of the data and the determination of the calculated values,SPSS(Statistical Package for Social Sciences)package program was used.

Results
As a result of this study; it has been found that there is a significant difference between creativity and job satisfaction levels.Furthermore,it was found that there is a significant difference between the weekly working hours,working years and gender variables and creativity and job satisfaction levels of the physical education teachers ($p<0.05$).
Discussion
As a conclusion,the level of job satisfaction of physical education teachers has affected the level of creativity.The attitudes of the people are affected by their mood.If the people have better attitudes towards their job,they get better in making judgements,their level of creativity increases and they have a room in the development chain and innovation.In addition,the study year,working hours and gender variables can change and direct the teachers'perception of job satisfaction and creativity levels.The high level of job satisfaction and creativity of physical education and sport teachers,who play an important role in the physical,social and spiritual development of the students,is important in terms of working more productively.
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ANALYSIS OF LIFE HISTORY INTERVIEWS OF TWO WOMEN PHYSICAL EDUCATION TEACHERS IN KOREA: 1960~2000

CHO, M.
INHA UNIVERSITY

Introduction
In the Korean society, a high glass ceiling index still highly exists. This research reveals the lives of the two female PE teachers, who both retired at 62 after engaging in the Korean middle and high school and had lived in male-centered Korean society. Also, this research exhibits the progress of change in the Korean school PE by interviewing the two physical education teachers' personal life history. By studying the progress of change of the modern-day Korean school physical education from 1960's, when these two teachers were young, and by researching their personal lives which has been highly influenced by their job, this research discusses the implication of the female physical education history in Korea.
Methods
This research used the structural reading as an analysis frame, suggested by Popular Memory Group of England for oral data research. For having a structural reading, the understanding of experiences, which are accomplished by the subject-positioning of female-subject, is needed. Therefore, the researcher has analyzed the family background of two Interviewees, their school lives from elementary to university, the rolls of female teachers when they entered the School of Education, the limitations of a PE teacher, and the future of two interviewees as variables.
Results
One of the interviewees was born in 1946 and the other was born in 1953. Both were interested in gymnastics and dancing, which led them to being professional athletes when they were young. With their passionate interest in teaching physical education, they entered into the School of Education. When they just became a teacher, the glass ceiling index was seemed to be very thick in male-centered Korean society. However, they got a good recognition by overcoming prejudice of women and became the first female supervisors of the Seoul Metropolitan Offices of Education. Finally, they became the admired principal in Korean middle and high school.
Discussion
In the past, Korean society was severe male-centered because of Confucianism. Therefore, two interviewees encountered many difficulties as a female physical education teacher in the Korean society. At the first time, they were frustrated and disappointed. However, they had overcome prejudice of women, male-centered Korean athletic culture, and multiple roles in their family. The motivation of two physical education teachers was their strong willingness to develop themselves and support of their family under any circumstances. Two narrators have become the cornerstone of establishing Korean female physical education by showing their valuable existential lives.
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Contact
phycmh@inha.ac.kr

THE EFFECTIVENESS OF AN EXPERIENTIAL LEARNING PROGRAM TO PROMOTE STUDENTS' TEAM BUILDING IN UNIVERSITY PHYSICAL EDUCATION

TAKANASHI, M.1, SHIMIZU, Y.1
1:INTERNATIONAL CHRISTIAN UNIVERSITY

Introduction
As students' maladjustment has become one of the eminent issues, Japanese universities are in need of special curricula for freshman students. This study aimed to examine the effects of an experimental learning program designed to promote interpersonal communication and team building in university physical education.
Methods
The subjects were 16 university students (2 male and 14 female) who took the selective course 'Team Sports' from April to June of 2016. The experimental learning program in the course was designed to help students 1) build relationships with others, 2) review that experience, 3) appreciate various perspectives in sharing their reviews with others and 4) cultivate new awareness. The subjects were asked to describe how they felt about the lessons freely on a reflection sheet. The contents of the reflection sheets were divided into seven categories ('Emotion,' 'Action,' 'Recognition,' 'Discovery,' 'Introspection,' 'Expectation' and 'Assumption'), then classified as either 'Group' or 'Individual' and as either 'Positive' or 'Negative,' so that there were 28 categories in total. After a tabulation of vocabulary from the reflection sheets of the first lesson (pre-test) and the last lesson (post-test), the contents in each category were analyzed with Wilcoxon signed-rank test.
Results

The number of 'Positive' descriptions significantly increased from the pre-test to the post-test in 'Recognition' and 'Discovery' under the sub-group 'Individual' and 'Recognition' under the sub-group 'Group.' The number of 'Negative' descriptions significantly increased from the pre-test to the post-test in 'Emotion,' 'action,' 'Recognition' and 'Discovery' under the sub-group 'Individual' and 'Action' under the sub-group 'Group.'
Conclusion
The results indicated that students noticed the changes in their psychological states in the experimental learning program. Some of the changes found in the students are consistent with the reports of a previous study that lessons with group problem-solving help students gain more insight into themselves and others (Shimizu and Miyazaki, 2012). However, the students also displayed a growing anxiety and confusion in the program when they encountered inner-group conflicts caused by differences in opinions or failure at tasks. This may be because they were still in the process of building relationships at the end of the program. Further research is needed to develop effective programs to promote students' university adaptation.
Reference
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A STUDY ON THE CHARACTERISTICS OF SCHOOL PHYSICAL EDUCATION IN ZAMBIA

YOKOTA, C., MAKIUCHI, K., FELIX, D., SAITO, K.
HIROSHIMA UNIVERSITY

Introduction
The Sustainable Development Goals states that sports contribute to the promotion of quality and learning of education. In most African countries, physical education (PE) lessons are not conducted in accordance with the curriculum (Hardman et al., 2005). According to an international survey of physical education, Africa's implementation rate in 2000 was the lowest in the world at 25%. Although the implementation rate has greatly increased, it still remains low as compared with other developing countries (UNESCO, 2014). It is presumed that the importance of school PE in Africa is becoming more apparent. Zambia is one country where the promotion of PE has increased, partially due to cooperation with Japan (Sawamura, 2000; Saito, 2006). However, there is still a scarcity of studies on Zambian physical education and sports in Japan. The purpose of this study was to clarify the current state of and explore issues of school PE in Zambia.
Methods
Information obtained from Zambia's education curriculum framework and physical education syllabus was reviewed to determine the standing of PE in the general curriculum and to have a closer view of the goals and content composition of PE in primary and secondary schools. Regarding the state of implementation of PE, we observed the educational environment and lessons of primary and secondary schools in Zambia. Additionally, the situation in the field was compared with the prescribed content of the curriculum.
Results
The primary school physical education curriculum considers PE as one part of the subject expressive arts, and there are likely many primary schools where PE is not carried out. In secondary schools, PE has been added as part of the national exam since 2014, but lessons are only implemented in the PE and Sports course of the Vocational Career Pathway. While the significance of PE is stated and many learning areas are prescribed in the syllabus, in practice it seems that PE has not been widely recognized and lessons weren't given in most cases.
Discussion
It was suggested that Zambian physical education regulations are far from the actual conditions of school PE. As teachers themselves have no experience with PE and its methodology, it seems reasonable that they cannot properly conduct lessons. In order to give students the opportunity to receive PE beyond those lessons carried out by Japan's volunteers, it is necessary to develop a training system for Zambian PE teachers.
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CONTENT STANDARDS' ANALYSIS AND INSPIRATION OF NATIONAL PHYSICAL EDUCATION HIGH SCHOOL LEVEL CURRICULUM IN THE UNITED STATE

ZHANG, J., YU, T.
UNION MOBILE FINACIAL TECHNOLOGY COMPANY LIMITED AND BEIJING NORMAL UNIVERSITY PE AND SPORT COLLAGE

This research used the methods of literature review and logic analysis to analyze the new high school physical education national curriculum standards, level outcomes and qualification appraisal application guide for 9—12 classes in the United State 2013. In January 2016, China enacted the latest ordinary high school physical education and health curriculum standard to carry out the basic task of "using ethics to educate people" and "health first guiding" ideology. It seeks to promote the students' three aspects of discipline core literacy which include sports ability, sports, health, behavior and moral character. By pointing out the similarities and differences among the high school physical education and health curriculum standard the present stage in China and the United States, it hopes to get some lessons and enlightenments to Chinese sports and health course teaching material compilation and classroom teaching.

DEVELOPMENT OF BADMINTON TEACHING ASSISTANT APP AND ITS EFFECTIVENESS IN PHYSICAL EDUCATION

LIN, K.C., LEE, D.S.
NATIONAL TSING HUA UNIVERSITY

Introduction
The purpose of this study is to develop a badminton teaching assistant APP for physical education courses. With new Kinect cameras, this system analyses student's dynamic badminton motions, evaluates the accuracy of the motions and provides instantaneous feedbacks

and automatic grading. With the aid of this APP, students can better understand their flaws in their badminton swings and record their learning history.
Methods
In this study, research method was based on quasi-experimental design and 90 students participated in this experiment. The experimental group consisted of 42 students assisted by the badminton teaching APP and the control groups consisted of 48 students instructed only by traditional teaching methods. The experiments, not including pre-test and post-test, took eight weeks. T-test was used for statistical analysis.
Results
The badminton learning achievements of experimental group in performing serve and net lift are significantly better than the control group ($p < .01$).
Discussion
The badminton teaching assistant APP developed by this study, with the functions of instantaneous feedbacks and automatic grading, can significantly enhance students' learning capability in serve and net lift compared to traditional teaching methods. The results of this study renewed the use of kinect to detect golf swing erroneous movements (Huang、Kuo & Lin, 2015). One major reason of this success is that this APP can clearly point out which particular motion within their swings needs to be improved. Moreover, the app can grade automatically the performance of serve and net lift as well. Therefore, the teacher can focus on the wrong motions and make certain adjustments to improve students' overall performances.
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PERCEPTION OF EXPRESSIVE BODY MOVEMENTS BY INDIVIDUALS WITH AUTISM SPECTRUM DISORDER

SEVDALIS, V.1,2, MAYER, J.3,4, FILER, K.P.4, KELLER, P.E.5,2, HEATON, P.4

1:UNIVERSITY OF COLOGNE, 2:MPI FOR HUMAN COGNITIVE AND BRAIN SCIENCES, LEIPZIG, 3:UNIVERSITY OF ROEHAMPTON, 4:GOLDSMITHS UNIVERSITY OF LONDON, 5:WESTERN SYDNEY UNIVERSITY

Introduction
Individuals with autism present impairments in social interaction and communication. Little is known about how music and dance are processed by these individuals, especially regarding the expressive and perceptual properties of such signals (Sevdalis & Raab, 2016). The present study investigated the perception of biological motion by individuals with Autism Spectrum Disorder (ASD) in point-light displays depicting dance.
Methods
Adult participants with ASD and a matched typically developing control group watched point-light displays (1-5 seconds long) depicting expressive and inexpressive dance movements in visual-only, audiovisual-congruent (i.e., synchronous music to movement) and audiovisual incongruent (i.e., asynchronous music to movement) conditions. The task was to identify the dancer's intended expression intensity (i.e., expressive vs. inexpressive).
Results
A signal detection analysis indicated that expressive body movements were identified reliably even for displays of 1s, and equally well in both ASD and control groups, with discrimination accuracy improving with increasing stimulus duration. Accuracy did not differ across visual-only, audiovisual congruent, and audiovisual incongruent conditions. Although individuals with ASD scored significantly lower than controls on self-report empathy and alexithymia scales, no relation between these measures and perceptual discrimination accuracy was found.
Discussion
The results are discussed in relation to the potential of music and movement signals to stimulate the latent communicative skills of ASD individuals (Sevdalis & Wöllner, 2016).
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Contact
v.sevdalis@uni-koeln.de

Conventional Print Poster

CP-SH02 Health and fitness in children and adolescents

RELATIONSHIPS AMONG WEIGHT PERCEPTION, DIET AND EXERCISE BEHAVIORS AND PHYSICAL FITNESS IN KOREAN ELEMENTARY SCHOOL STUDENTS

JUNG, A.R.1,5, LEE, D.T.2, HAN, Y.B.2, BAE, W.R.1,5, LIM, S.Y.3, LEE, J.H.3, CHOI, Y.H.4,5, YOON, K.H.4

1:KOOKMIN UNIVERSITY(KOREA), 2:KOOKMIN UNIVERSITY(KOREA), 3:THE CATHOLIC INSTITUTE OF U-HEALTHCARE(KOREA), 4:SEOUL ST. MARY'S HOSPITAL(KOREA), 5:MEDICALEXCELLENCE INC.(KOREA)

3: The Catholic Institute of U-healthcare, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, KOREA
4: Division of Endocrinology and Metabolism, Department of Internal Medicine, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, KOREA
5: MedicalExcellence Inc., Seoul, KOREA
Introduction

The prevalence of child overweight and obesity has been raised in recent years and it has been concerned by public health perspectives. It was obscure whether the Korean children perceive their weight accurately and adopt proper dieting and exercise behaviors. Thus, this study examined their body weight perception and their relationships to dieting and exercise behavior as well as physical fitness.
Methods
We recruited 10 years old boys (n=200) and girls (n=197). Their height, weight, and physical fitness (endurance run, sit-and-reach, grip strength, standing long jump) were measured. They responded to a questionnaire reporting weight perception as; too thin, slightly thin, about average, slightly fat, too fat. They reported experiences of engagement in weight control or management behavior such as dieting or exercise. Their weight status(BMI%ile) was categorized as; underweight (<5th %ile), normal weight (5th≤ to <85th %ile), and overweight/obese (85th≤ %ile). Dietary behavior and nutritional knowledge were also asked and scored. Daily physical activity level and interest level to exercise were also asked. Relationships among weight perception and reported and measured variables were analyzed.
Results
Weight perception of the children was not quite accurate when compared with the relative weight percentile. Girls considered themselves more to be overweight while boys did more to be underweight. Children perceived them overweight/obese were more likely to engage in weight loss attempts, in particular with exercise followed by diet. Dietary behavior and nutritional knowledge was not related to actual weight status, but more related to weight perception. Physical fitness level was related to weight status and perception. Dose response of fitness was noticed in endurance and standing long jump, but not in flexibility and grip strength. Physical fitness was higher for children who liked to exercise or were being active than those who did not.
Discussion
Collectively, Korean girls concerned more of their body weight than boys(Kim and So, 2014; Shin and Nam, 2015). Exercise and diet were the major weight management behaviors and dietary behaviors were more related to their weight perception than actual weight(Chung et al., 2013). Physical fitness level was more related to physical activity preferences than actual daily activity levels. Programs for early childhood health behaviors should be considered.
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GENDER DIFFERENCES IN DEVELOPMENT OF THE CHILDREN'S MOTOR ABILITY AND PARENTAL COGNITION OF ACTIVE PLAY

TAKEDA, N.
NAGOYA MANAGEMENT JUNIOR COLLEGE

Introduction
There has been considerable public concern in Japan in recent years concerning the decline in motor ability. The reasons for the decline in motor ability include the importance of Active Play is neglected in the consciousness of people involved with children. Takeda et al. (in press) pointed out that the frequency of Active Play recognized by parents is closely related to the results of many motor ability test items, rather than the development status such as height, weight, and month old. Therefore, this study aims to clarify the relationship between the gender difference of the development of motor ability and the parental perception of Active Play.
Methods
Total 33 children (12 boys and 21 girls) and their parents who attended two nursery schools were included in the survey. The mean age of children was 66.1 ± 3.8 months. The motor ability test was conducted 3 times (pre, post1, post2) in total every 4 months: 25m run, standing long jump, body supporting duration, ball catch, tennis ball throw, hand grip strength (right / left), and sideways jump iteration. Parents were asked to conduct a questionnaire survey on children's Active Play.
Results
In pretest, a significant difference was observed only in "tennis ball throw" (boys < girls, $t(32) = 4.98$, $p < .001$). In the motor ability test, Two-way repeated measures ANOVA was conducted. A significant interaction was observed in "body supporting duration" $F(2, 31) = 3.46$, $p < .05$, "hand grip strength (left)" $F(2, 31) = 7.60$, $p < .01$.
In the questionnaire survey, girls had more "Enrichment lessons" than boys ($t(32) = 2.38$, $p < .01$). Also, the "number of friends who usually play together" tended to be more for boys ($t(32) = 1.83$, $p = .08$).
Discussion
According to Takeda et al. (in press) "tennis ball throw" correlates with the "number of friends who usually play together". Therefore, the gender difference of 'ball throw' is predicted to be caused by the difference in the number of friends playing together.
There are many girls who attend some form of "Enrichment lessons" than boys, and gender difference of motor ability is thought to have occurred by limiting free time of Active Play.
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Contact
n-takeda@nagoya-su.ac.jp

TWO-WEEKS OF SPRINT INTERVAL TRAINING IMPROVES IVE ATTENTION IN UNIVERSITY STUDENTS

MEDEIROS, A.R.1, DE SOUSA, A.F.M.1, BENÍTEZ-FLORES, S.1, DEL ROSSO, S.1, STULTS-KOLEHMAINEN, M.2, BOULLOSA, D.A.1
1-UNIVERSIDADE CATÓLICA DE BRASÍLIA (BRASILIA, BRAZIL); 2-YALE NEW HAVEN HOSPITAL (NEW HAVEN, USA).

Introduction
Sprint interval training (SIT) has been shown to be associated with positive changes in aerobic capacity (Gist et al., 2014). Previous studies have suggested that improvement of aerobic fitness has a positive influence on cognitive function, including components of attention such as inhibitory control and selective attention (Guiney & Machado et al., 2013). Meanwhile, the relationship between exercise paradigms, such as SIT, and attention has not been elucidated yet. Therefore, the aim of this study is to investigate the influence of two weeks of SIT on attention in university students.
Methods
Seventy-two university students were recruited to participate in the study. Participants were divided into an experimental group (EG) and control group (CG) groups. SIT sessions were conducted with a cicloergometer [4 × 30 s of "all-out" efforts, interspersed with active rests

of 4 min (no load)]. Participants must reach >90% of maximal heart rate. Also, only individuals who completed at least 85% of workouts were included in the analysis. The final distribution of the samples was EG (n=26, 13 women, age=23.46 ± 5.13 yrs) and CG (n=19, 9 women, age= 25.05 ± 4.40 yrs). Components of attention (alerting, orienting, conflict) were assessed using the Attention Network Test (ANT) before and after two weeks (6 sessions of ~ 20 min) of training with SIT. The warm-up (5 min at 50-150 W) in the first and the last session was used to estimate VO2max with the Åstrand nomogram. Group comparisons were made using a two-way ANOVA with repeated measures.
Results
Only EG exhibited significant improvements in VO2max from baseline (EG = 36.94±8.59 vs. CG= 37.90±8.94 mL/kg/min) to post-training (EG = 41.06±6.42 vs. control CG= 38.47±9.53 mL/kg/min). There was a significant difference for the time factor [F(1,43)=10.23; p= .00; n2= .19] and an interaction between factors time and group [F(1,43)=6.74; p= .01; n2= .14] for the Conflict component of the ANT (related to inhibitory control and selective attention) revealing an improvement in this aspect of attention after the training period.
Discussion
Two weeks of SIT improved attention and aerobic fitness in university students. The results of the current investigation suggest that this exercise model may have led to neurobiological adaptations in only two weeks for cognitive processes related to inhibitory control and selective attention.
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Contact
mdt.ricarte@hotmail.com

THE EFFECTS OF EIGHT WEEKS PHYSICAL EXERCISES WITH MUSIC ON THE TEST ANXIETY OF ELEMENTARY SCHOOL GIRL'S STUDENTS

SAFAVI HAMAMI, S.
UNIVERSITY OF ISFAHAN

Introduction
Anxiety is the main emotion that plays an important role in the life of every individual. One type of the anxieties is test anxiety or perception of academic evaluation, which is one of the most important aspects of negative motivation. The purpose of the present study is to examine the effects of eight weeks physical exercises with relaxing music on the test anxiety of elementary school students.
Methods
Forty–five girl students with an age range of 10-12 years and high score in Philips test anxiety participate in this study. Then subjects randomly divided in three groups, physical exercise group (n=15), physical exercise with music group (n=15) and control group (n=15).Then after eight week intervention (3 session per week) subjects participate in post test. Analysis of Variance statistical tests were conducted on all data.
Results
The results show that in the post test, physical exercise with music group had the better score than the two groups and physical exercise group was better than control group ($p<0.05$).
Discussion
Stress contributes to anxiety, which can, in turn, interfere with students' academic performance (Hughes, 2005). Researchers have studied the use of music during physical exercise and have found it to be beneficial to reduce anxiety. Music takes the mind away from the exercise and creates another focus for the listener. Many people exercise to music only because it provides an enjoyable distraction and background during the physical activity, but music also increases the exercise output of individuals (Kendelhardt, 2003). Neurophysiological hypothesis is based on the release of the neurotransmitter dopamine in the striatum. Dopamine is released a few seconds before the emotional peak by anticipation and the predictability, provokes responses like feelings of security associated with pleasure.(Salimpoor .2011). Therefore, suggests that we should motivate the girls student to doing regular physical exercises with music in order to decrease the test anxiety.
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BENEFITS OF YOGA ON MENTAL AND PHYSICAL HEALTH: A 13-WEEK STUDY ON REQUIRED PHYSICAL EDUCATION CLASSES AT CHINESE UNIVERSITY OF HONG KONG

HON, S.
THE CHINESE UNIVERSITY OF HONG KONG

Introduction:
Yoga originated in India more than 5000 years ago and the practice of yoga can help to achieve the integration of body, mind and spirit. Yoga has been practiced as a low to moderate intensity physical activity in recent years and evidence suggests that yoga practices can bring beneficial effects on mental and physical health.
Purpose:
The purpose of this study was to determine whether a 13-week yoga practice of postures, breathing, and relaxing can improve the mental and physical quality of life of college age students.
Methods:
A sample of 40 students was recruited from university classes to participate in a 13-week yoga class. A pre-post test design was used for this study. Measurement on the physical aspects included the strength, balance, functional flexibility whereas the mental aspects included the emotion and stress reduction. Data were analyzed at the significance level of $p<.05$ for one group pre- and post-test of two data sets.

Results:
The Mann-Whitney showed significance at the p<.01 for the sit and reach flexibility test and A West showed significance at the p<.05 for mental component of the questionnaire.
Conclusions
This study suggests that a 13-week yoga class showed improvements of flexibility and self-perception of mental well-being of students who are novice yoga practitioners.

RESULTS OF A SOCCER TEACHING PROGRAM INTENDED TO HELP STUDENTS IMPROVE AND ACQUIRE KNOWLEDGE OF PHYSICAL FITNESS

TSUDA, R.

KANAZAWA MEDICAL UNIVERSITY

Introduction
The purpose of this study was to examine the effect of a soccer teaching program's validity to help students improve individual physical fitness, gain basic understanding and improve attitudes toward physical fitness.
Methods
The subjects were 40 junior high school students. In pre and post program, we conducted skill tests (ball juggling), physical fitness tests (150m sprint with changing direction ; 6 X 25m sprints with direction-changes with rest intervals of 30s) and a questionnaire regarding knowledge, conception and judgment aspects.
Results
Comparing pre-program test results with post-program results, we observed the following after completion of the program:
1) Subjects' ball juggling skills improved significantly.
2) Subject's sprinting mean-time results of 150m sprint with changing direction showed no significant difference.
3) The subjects felt that their understanding about method of enhancing the physical fitness had improved after-program questionnaire.
Discussion
These results suggest that this soccer teaching program improved knowledge toward method of enhancing physical fitness among participating subjects, although physical fitness levels could not be enhanced in this study.

THE TIME SPENT ON PHYSICAL ACTIVITY BY PRESCHOOL CHILDREN ON WEEKENDS -COMPARISON BETWEEN ACTIVE AND INACTIVE CHILDREN-

ISHIZAWA, J.1, SASAKI, R.2, YOSHITAKE, Y.3

1: SHIRAYURI UNIV. (TOKYO, JAPAN), 2: KEIO UNIV. (YOKOHAMA, JAPAN), 3: NIFS IN KANOYA (KAGOSHIMA ,JAPAN)

Introduction
Promoting physical activity (PA) among preschool children is very important. Previous studies reported that preschool children engaged in more total moderate and vigorous physical activity (MVPA) per day on weekdays than weekends (Ishii et al. 2015; Vale et al. 2010). Examining the time spent on MVPA, studies have shown that the pattern on weekdays was affected by preschoolers' lifestyle and MVPA average was lower throughout the day on the weekend compared to weekdays (Ishizawa et al. 2016). This study characterized the PA level and time spent on MVPA by active and inactive children on the weekend.
Methods
Participants were 371 preschool children (mean age: 5.6 ± 0.6 years). PA was measured using a triaxial accelerometer (Active Style Pro, Omron) for seven consecutive days. We examined their PA on the weekend (which was the off-day: either one or two days, depending on the preschool), when they did not attend preschool by measuring the time spent in MVPA. We compared the hourly MVPA patterns of the active children group (top 20%) with the inactive children group (bottom 20%).
Results
There was a significant difference in the total MVPA of the active group, which was higher than the inactive group on both the weekdays and weekend. The total MVPA on the weekends for the active children group showed that boys and girls engaged in MVPA for 93.8±17.4 mins/day and 85.3±22.5 mins/day respectively. In the inactive group, boys and girls engaged in MVPA for 23.7±7.8 mins/day and 16.9±5.8 mins/day respectively. There were no significant differences in the total MVPA per day between the boys and girls in the active group, but the boys in the inactive group engaged in more MVPA than the girls ($p<0.05$). Comparing the time spent on MVPA, the inactive group's PA per hour remained low all day. On the other hand, the active group's PA per hour was significant higher than the inactive group throughout the day (8a.m. to 8p.m.) for boys and girls ($p<0.01$). The MVPA of the active group increased after 10 a.m. and was observed to be the highest at 3 p.m.
Discussion
These findings suggest that active children engaged in PA on the weekend in the morning and afternoon. In contrast, inactive children mostly did not engage in MVPA throughout the weekend. Inactive children need to be encouraged to be active at least once a day to promote MVPA among preschool children on the weekends.
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Contact
ishizawa@shirayuri.ac.jp

STUDENTS' LEARNING EFFECTS OF IMPLEMENTING DIFFERENCE CHARACTER EDUCATION STRATEGIES FOR UNIVERSITY PHYSICAL EDUCATION COURSES

PAN, Y.H.1, HSU, W.T.2, LY, S.3, CHEN, C.H.4, CHEN, P.A.5

NATIONAL TAIWAN SPORT UNIVERSITY

Introduction

What kind of curriculum model can enhance pupils' character development in physical education? TPSR (teaching personal and social responsibility) provides a teaching guide to develop students' affective domain in physical education (Hellison, 2011). The present study would compare the students' learning effect in swimming courses between merging cooperative learning (CL) with TPSR model (CL-TPSR) and general TPSR model, which learning effects including learning motivation, responsibility, and motor skill of swimming.
Methods
The present study used a quasi-experimental design with pre- and post-test of the experimental group (CL-TPSR) and control groups (TPSR). The participants included 2 university physical education classes taught by one physical education teacher. There were 73 participants, with experience group 35 students (age=18.53±0.86 years old) and control group 35 students (age =18.87±0.45 years old), performing a 18 weeks swimming curriculum with 36 lessons. The research instruments included responsibility scale, learning motivation scale and swimming motor skill test. Multivariate Analysis of covariance was used to test difference between experiment and controlled group.
Results
The findings of research showed that CL-TPSR group could improve more learning effects than TPSR group, which dependent variables including learning motivation, responsibility, and swimming motor-skill. CL-TPSR model is worthy to develop for swimming curriculum in university physical education.
Discussion
TPSR is an alternative teaching model whose goals are to improve character development in physical education(Escartí, Gutiérrez, Pascual, & Llopis,2010). After integrating cooperative learning into TPSR, however, students have more teamwork, which are better learning effects than general TPSR model. Cooperative learning empower students to develop team affiliation which could promote interpersonal interactions. In summary, CL-TPSR model has a more positive learning process in physical education courses (Siedentop, Hastie, and van der Mars, 2011). In this present study, it is concluded that cooperative learning integrated into TPSR could improve students' learning motivation, responsibility and motor-skill of swimming. The curricular projects of hybrid model, both TPSR and cooperative learning strategy, will be good curricular projects of character education. It could be developed in physical education curriculum.
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Contact
a0922302951@gmail.com

Conventional Print Poster

CP-PM01 Game analysis

THE RELATIONSHIP AMONG THE ASSIST POSITION, THE ATTACKING STRATEGY AND SHOOTING AREAS IN SUPER BASKETBALL LEAGUE OF TAIWAN

LAN, Y.C.1, WANG, K.X.2, LIU, Y.T.2
1: NYMU (TAIPEI, TAIWAN), 2: NTNU (TAIPEI, TAIWAN)

Introduction
The importance of an assist in professional basketball is best understood in terms of its contribution to team points. NBA research has shown that each assist is worth 2.17 points and it contributed to approximately 49% of all points scored in League games (DuPree, 1998). Despite the important role of assist in basketball game, limited research has been focused on the statistics of assist in basketball games. The purpose of the study was to examine the relationships among assist positions, attacking strategy and shot position.
Methods
124 games of 7 teams from the Taiwan 2014-2015 Super Basketball League (SBL) were analyzed. The assist positions (paint, outside paint, 3pt-zone), attacking strategies (fast break, early offense, set offense) and shot positions (paint, outside paint, 3pt- zone) were recorded when an assist occurred. Three-way (3 assist position x 3 attacking strategy x 3 shot position) repeated measures ANOVA on the number of assist were performed. Two separate observations were done to calculate intra and inter-rater reliability, Cohen' Kappa was 0.92 and 0.86. The significance level was set at $p < .05$.
Results
The results showed that there were 29 assists per game in Taiwan SBL and the interaction effects of assist position, attacking strategy and shot position reached a significance level, $F(8, 48) = 119.36$, $p < .05$. For the assist positions, the 3pt-zone (13.50) was higher than outside paint (8.41) and paint (7.19). For the attacking strategies, set offense (18.93) was higher than early offense (8.51) and fast break (1.65). For the shot positions, 3pt-zone (15.78) was higher than paint (9.18) and outside paint (4.13).
Discussion
Our findings showed that the average number of assist per game in SBL was similar to Spanish Basketball League (Puente et al., 2015). From the temporal perspective, our study showed that the set offense had the most assists than the other attacking strategies. From the spatial perspective, the highest number of assist occurred at the 3pt-zone and the 3pt-zone was also the area where the most assists were received for shooting. Generally speaking, a player receives a pass from the 3-pt zone and immediately shoots also from the 3-pt zone in a set offense is a popular scenario in a SBL game.
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ANALYSIS OF GAME ACTIONS IN PROFESSIONAL MALE PADEL.

MELLADO, O., BAIGET, E., VIVES, M.
UNIVERSITAT DE BARCELONA (INEFC)

Introduction
The goals of this study were, firstly, to define a technical and tactical analysis standardized tool for padel; secondly, to carry a descriptive analysis of play actions and tactical aspects in masculine professional padel.
Methods
To this end, an observational design was employed, constructing an observational instrument designed ad hoc. The reliability of the observation was determined through the level of intra and interobserver correspondence. A total of eight padel matches were analyzed, pertaining to the final phases in various rounds of the World padel Tour 2014 circuit, in which a total of 32 professional players participated. Data was registered regarding the player executing each shot, his situation in the playing court, the type of shot, the trajectory, depth and route of the ball and the consequence of the analyzed shot for a total of 8,581 shot actions.
Results
Amongst the types of shots executed the following stand out, in order of frequency: forehand and backhand volleys (16,6% and 13% respectively), backhands (12,4%), first serve (11,2%) and forehand (10,7%). Crossed trajectories (57,5%) prevail over parallel trajectories (42,5%). The zone in the playing field from which the most shots were executed was the back court (49,1%), followed by the net zone (26,4%) and the transition zone (19,3%). Percentages were registered for intercepted shots (87,6%), unforced errors (5,5%), winning points (4,7%) and forced errors (2,1%). The shots with which the most number of winning points were registered were the smash (45,9%), forehand drop shot (7,9%), the forehand and backhand volleys (5,7% and 3,4% respectively) and the tray shot (3,5%).
Discussion
In conclusion, the most frequent shots in a professional Padel match are: drives and backhands from the back court, volleys, tray shots and smashes. In every game point there often is a long exchange of shots, specially crossed shots, which mainly finish with unforced errors by the opponent or volley, smash or tray shot winning points.

MARKERS OF SUCCESSFUL FOOTBALL MATCH PLAY AT THE UEFA EURO 2016

ZAIZAFOUN, F., VOLK, N.R., FERRAUTI, A.
FACULTY OF SPORT SCIENCE RUB (BOCHUM, GERMANY)

Introduction
In football, game analysis represents an objective examination of individual and team related technical and tactical as well as physical markers that occur during the competition. These data can provide valuable information for the team specific short term training prescription as well as for the identification of general successful strategies and for their changes during the long term game development. The purpose of the present study was to identify the more general successful markers that influenced the match results during the UEFA Euro 2016.
Methods
The Tournament consisted of 51 football matches which can be divided into 36 games in the group stage and 15 games in the knockout phase. The data were obtained from the UEFA website (www.uefa.com/uefaeuro). In this study, 17 variables were statistically analyzed and processed over the entire play time. These variables were divided into four groups: variables related to goals scored, to offense and defense tactics and to distance covered. The reliability of the observation system was previously confirmed by Castello et al. (2012). The resulting values of Cohens Kappa ranged between 0.93 and 0.97. A Krustal-Wallis H was carried out to calculate differences between winning, losing and drawing. Additionally, a discriminant analysis was conducted to find the statistical variables that discriminate between the winning (W), losing (L) and drawing (D) teams.
Results
Statistical analysis showed that the winning teams were significantly higher than losing or drawing teams for the following variables; the mean of total shots per match W: 15.3±5.2, $p<0.01$ vs. L: 11.2±5.1, D: 12.3±7.0, shots on the target 6.0±2.8, $p<0.01$, L: 2.9±1.8, D: 3.7±2.4 and effectiveness of shots 39.6±14.0%, $p<0.01$, L: 25.5±13.6, D: 31.2±21.2. In the second group of variables such as pass number, incoming pass, pass percentage and percentage ball possession no significant differences were found between the three groups. In addition, no further differences could be found in the third and fourth group of variables. Further, we found no significant differences in the distance covered during the total game time between groups. The first discriminant analysis show that the greatest discriminatory power were total shots (SC=0.30) and ball recovered (SC=0.37).
Discussion
Results from the present study indicate that the number and the effectiveness of shots on target are important markers for successful match play in football. Surprisingly, percentage ball possession and running distance were not discriminating between the groups. It can be speculated that the game is either developing more into an offensive direction or these findings are specifically only for the tournament match play and not for Liga systems.
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Contact
Fadi.Zaizafoun@rub.de

RELATIONS BETWEEN MEN'S EFFICIENCY IN BLOCK AND ATTACK AND THEIR WEIGHT AND HEIGHT IN POOL B OF EUROPEAN VOLLEYBALL CHAMPIONSHIP 2015

STAMM, R., STAMM, M., TOOP, R., TUULA, R., JAIURUS, A.
TALLINN UNIVERSITY, SCHOOL OF NATURAL SCIENCES AND HEALTH

Introduction
Proficiency in volleyball depends on technical, tactical, physical, psychological and anthropometric factors (Fattahi et al.2012; Přidal et al. 2012). The aim of the study was to find relationships between the players' attack and block efficiency and their weight and height.
Methods

The subjects included the members of the Estonian, Italian, French and Croatian national teams who participated in Pool B of the European Championship. The proficiency data of all the 6 matches were recorded by the program Data Volley (2007).
Results
The mean height of the sample of men was 200.2 cm (SD 6.9). The mean weight of the subjects was 93.5 kg (SD 9.2). Spikes were performed by 29 players in total. On average, 36 attacks per player (SD 29.6) were performed during the pool tournament. Weight was in statistically significant correlation with the efficiency of attack (r= 0.518). Height was in statistically significant correlation with the efficiency of attack (r= 0.534). The number of attacks and attack errors did not show any statistically significant correlation with height and weight. Blocks were performed by 28 players in total. The player who performed the greatest number of blocks (37) was a middle blocker. Correlation analysis showed that height and weight had no statistically significant correlation with the number of blocks, block errors and efficiency of block.
Discussion
Although the current study did not show any correlation between the performance of the block and the players' height, one can say that using taller players as middle blockers shows that useful blocking (the ball remains in possession of the blocking team) is as important as efficient block in present-day volleyball at the international level. Useful blocking gives the defending team the opportunity for setting up and attack again. As a conclusion, it was found that height and weight correlated with the efficiency of attack. There was no correlation between the anthropometric characteristics and block efficiency. Based on above mentioned we can think that the efficiency of block depends less on the anthropometric characteristics and more on the other factors, may be psychological ones as reaction speed, anticipation time.
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QUANTIFYING TEAM SYNCHRONIZATION BY TRANSFER ENTROPY IN SOCCER GAMES

TANAKA, T.1, GOUDA, N.2, YAMAGUCHI, T.3, MAGOME, T.4, NAKATA, K.4

1: HITACHI, LTD., TOKYO, 2: HITACHI, LTD., TOKYO, 3: HITACHI KASHIWA REYSOL CO., LTD., 4: OSAKA UNIVERSITY GRADUATE SCHOOL OF MEDICINE

Introduction
Data analytics using advanced sensors such as GPS and accelerometer is introduced actively into sports. In professional team sports, the quantitative evaluation of team performance is needed to achieve advantageous situations in team tactics. Therefore, we focus on the teamwork that is one of the most important factors in team performance, and propose a new method to quantify the synchronization between players in team sports.
Method
We utilize transfer entropy that is one of the methods to analyze the synchronization between two time-series signals because transfer entropy is more suitable for estimating the causal relationship than the other analysis methods. In our proposed method, we estimate causal relationships between players' movements by calculating transfer entropy from time-series movement data of players as the following steps:
(1) Calculate the exercise intensity of each player every second from 20 Hz sampled acceleration data measured by the wearable sensor.
(2) Calculate the normalized random variables from the exercise intensity.
(3) Calculate transfer entropy between two series of random variables for each pair of all players in the field.
We compared the characteristics of the transfer entropy in the soccer game (90 min.) to the subjective assessment by sports experts. For this evaluation, we measured acceleration of all players except goal keepers in the soccer game at the academy of the Japanese professional team. At the same time, the scouting expert of the professional team extracted the periods when the one team attacked organizationally. After the measurement, we calculated the transfer entropy every minute in the game and compared the transfer entropy of the extracted period to that of the other period.
Results
During the periods when the scouting experts considered the one team attacked organizationally, the transfer entropy from the defending team to the attacking team is statistically significant high ($p<0.05$). On the other hand, by using the conventional method, the players' physical performances of both situations are not significant difference.
Discussion
This result indicates that our proposed method is more useful for the evaluation of team performance than the traditional methods.
Acknowledgement
Data were obtained according to the standards of internal review board on R&D group, Hitachi, Ltd.
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Contact
takeshi.tanaka.nz@hitachi.com

IDENTIFYING THE KEY PERFORMANCE INDICATORS IN PHYSICAL AND TECHNICAL RELATED SITUATIONAL VARIABLES IN 2012 CHINA SUPER LEAGUE

GAI, Y.

FACULTAD DE LA CIENCIAS ACTIVIDAD DE FÍSICA Y DEL DEPORTE

Introduction
The aim of this study is to identify the key physical and technical performance indicators related to the situational variables such as opponent quality (end-of-season rank), match location (home and away), match outcome (the gap of goal scored between home and away team) in the China Super League during the 2012 season.
Methods

Data were collected by using a computerized match analysis system from 240 matches (n=240). 16 teams' performances were gathered by Amisco Sports Analysis Services. The team's physical performance included the distance covered at high intensity, sprinting and total distance. The variables were studied according to the match periods and the possession of the ball: total match; total match in possession; total match out of possession; 1st half; 1st half in possession; 1st half out of possession; 2nd half; 2nd half in possession; and 2nd half out of possession. The team technical's performance only included the full match.
Results
According to the team physical performance such as total distance in possession, total sprint in possession, total distance out of possession, 1st half of full distance out of possession and 2nd half of full sprint in possession had showed great significant related to the situational variables during match play (value from P**<0.01, P***<0.001). According to the team's technical performance, only shots on target showed great significant related to the situational variables during match play (value P***<0.001). In contrast, the full match of physical's performance was not significant for any variable.
Discussion
In conclusion, the results of this study provided the key performance during the match play in CSL, and it should be taken into consideration by the coaches' staff in order to prepare more specific and accuracy strategies according to match demands.

EXPLORING THE EFFECT OF DIFFERENT OPPONENTS AND MATCHES ON PERFORMANCE INDICATOR OF INDIVIDUALS IN TABLE TENNIS - A CASE STUDY

CHUANG, K.L., TANG, L.Y., SYU, J.Y., LIU, Y.T.
NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction
In table tennis, the scoring related measures, the landing area of the specific stroke (the first, second, third, and the fourth stroke) in a rally, as well as the effectiveness of the types of stroke or footwork used have been considered as the performance indicators (Malagoli Lanzoni, Di Michele, & Merni, 2014). In addition, the characteristics of each stroke such as the flying times (FT), stroke times (ST), return angles (RA), return times (RT) and return displacement (RD) of the ball may also be considered as the performance indicator in table tennis. In practical application, the performance indicators are often used to assess the performance of an athlete in a match or a series of matches based on data observed within a match or a few matches, and the match performance is often influenced by the player-player interactions (O'Donoghue, 2014). The purpose of this study was to examine the effect of opponents on the performance indicators of an elite table tennis player in a series of matches.
Methods
Three single's matches from 3 international competitions where the Taiwanese table tennis player, who has been in world Top 10 rankings for the past 5 years, played against 2 different players were selected for analyses. The number of strokes, type of strokes, event time and landing position of each stroke were recorded using SIMI SCOUT software. There were total 18 games that consisted of 320 points and 3530 events analyzed. The kappa statistics was used to evaluate the intra- and inter-raters reliability. All kappa values were over .9. For the landing position and event time, the intra- and inter-rater average discrepancies were below 6 cm and 30 ms, respectively. The Logistic regression was performed to examine the contribution of the FT, ST, RA, RT and RD of the ball to predict scoring performance of each point using R language.
Results
The test of the full model against a constant only model was statistically significant in Austrian open (chi square = 11.64, $p < .05$) and Asian championships (chi square = 18.25, $p < .05$), indicating that the predictors as a set reliably distinguished between acceptors and decliners of the offer. The Wald criterion demonstrated that ST, RA and RD made a significant contribution to prediction in Asian championships open, but only RD made a significant contribution to prediction in Austrian open.
Discussion
This study demonstrated the tight link between proposed performance indicators of table tennis (e.g., RA, RD, and ST) and the outcome in a series of matches, which may provide the rich application information for coaches and athletes as guidance in preparing future competitions.
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EFFECT OF COMPETITIVE LEVEL AND POINT DIFFERENCE IN GAME ON THE SHARING

SUGIMOTO, R.1, YANAGIYA, T.1
JUNTENDO UNIVERCITY(JAPAN)

Introduction
There are some factors, which influence the victory or defeat of squash games. Of these, racket-work and footwork at the court during match are thought as important factors. Regarding footwork, to occupy T area during game is thought as an important because T area is the center of the court, and shortest position from every area of the court. So it is possible for players being inside the T area to catch up with the ball even if and advice players to return to T area after they shoot the ball. However some previous study reported skilled players are apt to stay longer time around T area, and other previous study reported vice versa (Vuckovic, 2009) . Therefore, we hypothesized that sharing time of being T area during match depends on not only which player is longer than the other, but also the skilled level of the enemies. So the purpose of this study was to investigate if there are competitive level differences in sharing time being T area during match or not, and if differences are affect by victory or defeat, or score.
Methods
Subjects were twenty female college students who participated in all Japan Inter-college Squash Championships in 2016 were analyzed. We recorded games with digital video camera at 30 fps from backward of the squash court, so as 'T area' to be positioned the center of screen. They were divided into two groups, according to be the representative of Japan (skilled players) or not (unskilled players). 15 games were analyzed in this study. T position was defined as an intersection of half line and short line. In addition, T area was defined as the area from 6.2m side-to-side, and 1.6m lengths backward from T position. Sharing time was defined as the time when foot contact on T area. Video frames were counted to measure staying time. Analyzed games were classified as the interaction between closed game and much difference game, skilled players each other, unskilled players each other. However, only tiebreaker was used for closed game analysis. Only matches differed over 6 points were used as much difference game.

Results and Discussion
There was no difference in sharing time of T area in closed games among any groups. However, significant differences in sharing time were not seen at all in much skill difference game, among skilled players. Sharing time of skilled players was significantly longer than unskilled players at much difference games. These results may suggest that sharing time of winner may not always be longer than loser in much difference game of skilled players with each other. It may be possible that other factor, racket skill, fitness, or mental toughness for example may affect the victory or defeat.
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RELATIONSHIP BETWEEN SPEED CHANGE AND SUBJECTIVE EFFORT FOR TOP-LEVEL HIGH-SCHOOL 400-M HURDLE RUNNERS

YUSUKE, O.
HIROSHIMA UNIVERSITY

Introduction
The purpose of this study is to clarify the relationship between performance, race pattern, and subjective effort in the 400-m hurdle race (400-mH).
Methods
For this research, races in inter-high-school competitions in Japan held during 2016 were video recorded using several cameras, panning from the starting line to the finish line. Using the recordings, the time from the flash of the starter's gun to the touchdown time immediately after the each hurdle were obtained for each hurdler. Furthermore, a survey of subjective effort during the race was conducted by applying the mail-survey. To achieve this, the race was divided into sections as follows: Section 1 (S1), which concerns the period from the start of the race to the second hurdle (H2); Section 2 (S2), from H2 to H5; Section 3 (S3), from H5 to H8; and Section 4 (S4), from H8 to the finish. Along with the obtained touchdown times and subjective effort, the running velocity, the rate of deceleration, the rate of section time in race time, and the subjective effort made in each section were calculated, respectively.
Results
Our main results showed the following:
1) Subjective effort during the race was approximately 85% during S1, but individual differences varied widely. Effort declined somewhat in S2, before gradually increasing again from S3 to the finish.
2) In S2 and S3, the subjective effort was related to the relative pace in that section. In addition, subjects with a high relative pace in S3 produced high subjective efforts in S3 and S4. In addition, the slowest runners during S4, as well as runners who exhibited a large drop in speed in S3 and S4, made a high subjective effort in S4.
3) For athletes competing at the inter-high-school stage, the higher the performance, the faster the speed throughout the entire race, and the lower the speed decrease from S2 to S3, the slower the relative pace at S1 and the faster at S3.
4) As a result of a cluster analysis based on the rate of section time in race time, the race patterns were classified into the categories of "speed maintenance" and "speed reduction." Although the number of high performance athletes included in the "speed maintenance" category was high, it included various different levels of hurdlers.
5) Athletes in the "speed reduction" category were higher efforts in S1 than the "speed maintenance" category, and their relative pace was no significant difference only in S3.
Discussion
From these facts, it was found that in high-school-level 400-mH, the relative pace of S1 is slow and that adopting a race pattern that involves setting a relatively high pace at S3 is important. Additionally, it is suggested that the subjective effort made in S1 is related to the race pattern, i.e., "speed maintenance" or "speed reduction," but it is not related to the relative pace of S3, which correlates highly with the recordings.

FUNCTIONAL SWING-SUPPORT LEG STRENGTH EXERCISES FOR SPRINT RUNNERS

KIJIMA, K.1, ISHIZUKA, H.1, OKAMOTO, D.1, KARASUNO, R.1, URATA, T.2, ISHIKAWA, M.1, ITO, A.1
1)OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES, 2)KANSAI UNIVERSITY

Introduction
The strength training in consideration of the movement specificity is important for high level athletes. In sprint running, several specific strength training, especially for extension and flexion of hip joint, has been proposed to improve sprint performance. However, it should not be fully considered in light of the functional muscle activation pattern and working range of muscle length. Therefore, the purpose of the present study was to examine the muscle contraction types and the muscle activation of hip extension/flexion muscles during exercises in order to compare the muscle contraction types and muscle activation during sprint running movements.
Methods
The 10 male sprinters participated and performed six functional strength training exercises which worked out in the field: The hip extension (support-leg movement) and flexion (swing-leg movement) exercises were performed without and with the manual concentric and eccentric contraction loads, respectively. The hip joint angles and angular velocities were measured by 2D kinematics (60 fps) and simultaneously surface electromyogram (EMG, 1 kHz) of four muscles (m. iliopsoas, m. rectus femoris, m. gluteus maximus, and m. biceps femoris) were measured during exercises. Length changes of muscle-tendon complex (MTC) of the above four muscles were calculated using the Hawkins & Hull model (1990).
Results
In the hip-flexion (swing-leg) exercises, the iliopsoas MTC shortened with high muscle activities. With loads, that EMG was increased, but there are not any significant differences between manual concentric and eccentric contraction loads. In the hip-extension (support-leg)

exercises, the gluteus and biceps femoris MTC shortened with high muscle activities. With loads, those EMG were increased, but there are not any significant differences between manual concentric and eccentric contraction loads.
Discussion
These results are in line with the muscle contraction types and muscle activation during sprint running movements (Baba et al., 2000). The manual concentric and eccentric loads with the functional movement phases can provide the stimulus for training load of sprint runners functionally.
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DOES FOOT STRIKE PATTERN DURING SHUTTLE RUNNING CHANGE WITH RUNNING PACE?

TAKESHITA, T., NORO, H., SUGIMOTO, R., YANAGIYA, T.
JUNTENDO UNIVERSITY

Introduction
Foot strike pattern during running is a classification how subject touch the foot on the ground, and one of the topics in the research area of sports sciences. In most of these studies, foot strike pattern was observed in the experiment on the assumption that subjects run for long distance at the constant speed. It has been reported that most of subjects run with the rear foot strike in the long distance race (Hasegawa et al, 2007 ; Larson et al, 2011). Moreover, foot strike pattern is reported to change into fore foot strike from rear foot strike as running speed increased (Breine et al., 2014 ; Forrester and Townend, 2015). However, in the most of sports event, like ball game or racket sports, athletes run for not so long distance, and at not constant speed. Therefore, investigating the effect of running speed on foot strike pattern during not race running, like shuttle running training, may help the coaches and/or athlete to have knowledge.
Methods
Sixteen healthy university squash players (including 7 females) had shuttle running for 16 times in 24 meters for one way in a gymnasium. The pace was gradually decreased by 1 sec from 23 sec to 8 sec. They had 30 sec rest intervals between trials. Running motion had been captured with digital video camera at 240 fps in the middle point of the pass way. Foot strike pattern, fore foot strike (FFS), mid foot strike (MFS) and rear foot strike (RFS) was distinguished followed by Hasegawa et al. (2007).
Results
In all subjects, foot strike pattern did not change with increased running pace. Foot strike pattern in some male subjects changed from RFS to MFS or FFS, at about 9 sec pace, though others remained RFS. Inter-individual variance was seen especially in slow paces. Almost all female subjects ran with RFS in every pace.
Discussion
Changes in foot strike pattern with changes in shuttle running pace didn't agree with the results of previous studies, that is, the changes in long distance running. In shuttle running, runners took into account to stop or turn at once and try for speed up or efficiency of energy. It might be possible for them that foot strike pattern didn't correspond with the results of previous studies.
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Contact
tomonaritakeshita@gmail.com

EFFECT OF DIFFERENT TRAINING METHODS ON 100 M SPRINT PERFORMANCES

CETIN, E., HINDISTAN, I.E., OZKAYA, Y.G.
AKDENIZ UNIVERSITY

Introduction
Many different sprint training programs, including sprint-resisted and -assisted methods, have been used with the aim of improving maximal sprint running performance (Paradisis and Cook, 2006). Uphill and downhill runs have been observed in many studies that have improved sprint performance and have been recommended by trainers (Paradisis et all., 2009; Arakawa, 1993.)
For this reason, the purpose of this study is to examine the effect of 8-week sprint training applied on sloping and flat surfaces on 100 m sprint performance with 10 m intervals.
Methods
Twenty male students (Combine(Com) Training Group(n=6), Horizontal(H) Training Group(n=7), Control(C) Group(n=7) participated in this study.
Com group did a 2-set combined (uphill+downhill) workout in total in a way that 4 sprint repetitions would make 1 set on a 4o sloping tartan surface with a high start.
H group did 4 sets of the sprint with maximal velocity with a high start, in a way that 4 repetitions of 25 m would be 1 set.
C group maintained their normal physical activities throughout the experimental period without performing any kind of training.
Initially, after 4 weeks and after 8 weeks, 100 m sprint rating of the individual was measured with photocells placed at the start and finish lines. Photocells were used to assess sprinting performance and the 10 m time splits of the participants.
Results
At the end of 100 m RV, 8-week training program, the velocity increased to a statistically significant extent for Com group as 4.13%, and for H group as 2.35%. When the velocity values with 10 m intervals along the running velocity(RV), 100 m were examined, it was observed that H and Com athletes reached their maximum velocities in the pre-training 40m-50m interval, and in the post-training 30m-40m interval, respectively. The athletes of both groups retracted the distances to reach their maximum velocities 10 m behind after the training program.
Discussion
H completed their running performances with 93.22% of their max RVs (0.74% better than the previous performance). While this is showing that they have acquired a better acceleration phase during the start, the preservation of %maxRV could only be sustained until last 20 m. The %maxRV obtained in the 80m-90m interval was determined to be less when compared to the pre-training

Com retracted its interval 10 m behind to reach the maximal velocity as the H group did, and increased its maximal velocity by 1.36% after the training program. After having obtained the maximal velocity, the velocity managed to remain above 8 m/sec between 30-70 m.
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Contact
emelcetin@akdeniz.edu.tr

MECHANICAL PROPERTIES ON QUADRICEPS FEMORIS MUSCLES AND PATELLAR TENDON UNDER THE ISOMETRIC KNEE EXTENSION

TANAKA, S.1, IMAWAKA, T.2, DJORDJEVIC, S.3, TSUNODA, N.2

1: KOKUSHIKAN UNIVERSITY (TOKYO, JAPAN), 2: GRADUATE OF SPORT SYSTEM, KOKUSHIKAN UNIVERSITY (TOKYO, JAPAN), 3: UNIVERSITY OF PRIMORSKA (KOPER, SLOVENIA)

Introduction
The mechanical properties of the muscle-tendon complex are important factors for producing muscle force during exercises. Recently, a method of muscle contraction sensor (MC sensor) was developed to assess the mechanical property within the muscle and tendon (Djordjevic et al., 2011, 2014). However, there is not so report that to address the mechanical properties of muscle-tendon complex in a process of muscle force production. Therefore, the purpose of this study was to objectively evaluate the mechanical properties on quadriceps muscles and patellar tendon in the isometric contraction by MC sensor.
Methods
Fourteen males (age: 25.5±5.5yrs, Height: 173.1±7.1cm, Weight: 69.2±11.8kg, %Fat: 16.6±5.2%) without disabilities to knee joint were participated in this study. Knee extension torque during isometric contractions at knee angle of 70 degrees was measured using a dynamometer (Biodex co.). The relative value to the peak torque was calculated for all the subjects. The tension of muscle belly (FMC) as an index of mechanical properties of quadriceps femoris muscles consisting of vastus medialis (VM), rectus femoris (RF) and vastus lateralis (VL) was assessed by MC sensor method (TMG-BMC co.). And also, tension of patellar tendon (PT) was measured in all the subjects. A small chip shaped sensor was attached to the skin on each muscle and patellar tendon (Djordjevic et al., 2011, 2014). Signals from the MC sensor in the resting stage and also during the muscle contractions were measured for all the subjects.
Results
FMC of quadriceps muscles showed a high value in increasing the muscle force. FMC of VL was significantly higher than that of VM and RF by 70% to 100% of MVC. In addition, a high linearity was observed between the muscle force and FMC of quadriceps muscles (VM: $r = 0.999$, RF: $r = 0.998$, VL: $r = 0.996$). On the other hand, FMC of PT showed a peak value only at 20% of MVC, which indicated an almost constant tension over 30% of MVC.
Discussion
In this study, it was found, that the signals from the MC sensor on quadriceps muscles were greatly correlated with the muscle force produced during the isometric contraction. However, FMC on PT showed almost constant values over 30% of MVC. From these results, it is suggest that the mechanical properties on quadriceps muscles may reflect to the level of muscle force production during the isometric contractions.
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Contact
st4986@hotmail.com

LANDING IMPACT FORCE AND LEG STIFFNESS ASYMMETRY WITH CHANGES IN HEIGHT

WANG, L.I., GU, C.Y., GAO, J.J., LI, X.R.

NATIONAL DONG HWA UNIVERSITY

Introduction
The drop landing (DL) task has often been used to quantify risk factors for lower extremity injury by vertical impact force (I-vGRF) (Decker et al., 2003) and leg stiffness (Wang et al., 2015). Side-to-side asymmetry during landing tasks has been suggested to be a precursor to lower extremity injury (Bates et al., 2013). The I-vGRF increases with drop height during landing tasks (Wang and Peng, 2014), which may negatively influence neuromuscular controls of side-to-side symmetries and increase the risk of lower extremity injury (Bates et al., 2013). The aim of this study was to explore the influence of drop height on asymmetry in I-vGRF and leg stiffness during DL.
Methods
Nine college students from the physical education department participated in the study. The subjects performed DL tasks from 40 and 60 cm drop heights (DL40 and DL60). The kinematic data were recorded using the Qualisys Track Manager motion capture system with 8 Qualisys infrared cameras, and ground reaction forces were measured using two AMTI force plates. The data were analysed using the Motion Monitor analysis software. Side-to-side differences in I-vGRF and leg stiffness (Kleg) were analysed using a repeated-measures t-test. The significance level was set at $\alpha=0.05$.
Results
The absolute difference in side-to-side peak I-vGRF at DL60 (452.78 ± 194.37 N) was significantly greater than that at DL40 (153.11 ± 150.42 N; $P = 0.002$). The absolute difference in side-to-side Kleg significantly increased with drop height in the DL task (DL40=2250.19 ± 1239.27 N/m; DL60=3801.15 ± 11651.13 N/m; $P = 0.039$).
Discussion
Investigation of asymmetry during drop landings over increasing vertical heights may provide new insight into key factors that may mitigate the risk of lower extremity injury. It was found that side-to-side asymmetry for I-vGRF and Kleg significantly increased from DL40 to DL60. Previous studies have shown that increased stiffness produces a larger I-vGRF during landing (DeVita and Skelly, 1992; Myers et al., 2011). Therefore, greater stiffness asymmetry may produce greater I-vGRF asymmetry, leading to greater knee instability and high ACL injury risk (Bates et al., 2013). Greater I-vGRF and Kleg asymmetry were found at DL60, which may be related to the higher rate of ACL

injury. Thus, Kleg asymmetry during landing may be used when screening for ACL injury. Future studies should evaluate asymmetry in kinematic and kinetic variables as predictors of future injury.

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Contact
tennis01@gms.ndhu.edu.tw

STRUCTURAL MUSCLE CHARACTERISTICS IN MUSCLE CONTRACTION UNDER TRANSVERSE LOADING

RYAN, D.1, STUTZIG, N.2, SIEBERT, T.2, WAKELING, J.1

1: SFU (BURNABY, CANADA), 2: US (STUTTGART, GERMANY)

Introduction
External forces from our environment can translate to transverse forces on our muscles. For example, in shoulder muscles when carrying a backpack, or in the gluteal muscles when we sit down. Studies in rats have shown that transverse loads affect muscle force output in the longitudinal direction (Siebert et al. 2014), where increases in load decreased maximum force. Changes in muscle architecture during contraction may contribute to the observed force decrease. The aim of this study was to quantify changes in pennation angle, fascicle dimensions and muscle thickness (Randhawa et al. 2015) during contraction under external transverse load.
Methods
Electrical stimuli were elicited in the posterior tibialis nerve to evoke maximal force twitches in the right calf muscles using a high-voltage stimulator. Trials were conducted with transversal loading of 2, 4.5 and 10kg. A force plate was used to measure maximal twitch force.
An ultrasound probe was placed on the medial gastrocnemius in line with the transversal load to quantify muscle characteristics during muscle twitches. Digitization of the aponeuroses isolated the gastrocnemius for each frame, the muscle thickness was given by the distance between the aponeuroses. A Fourier transformation was applied to the isolated gastrocnemius, allowing the calculation of pennation angle, as well as transverse fascicle strain.
Results
Maximum twitch force decreased with increased transverse muscle loading. The 2, 4.5 and 10kg trials showed a force decrease of 10, 13 and 16%, respectively. Loading of the muscle resulted in a decrease in the muscle thickness and pennation angle, with higher loads causing greater decreases.
During twitches the muscle transiently increased in thickness and pennation. Higher transverse loads showed a reduced increase in muscle thickness. Smaller increases in pennation angle and fascicle thickness strain also occurred with higher external loading.
Discussion
Transversal loading has an impact on muscle deformation and contraction dynamics.
In this study we showed that increased transversal loading caused a decrease in ankle moment, muscle thickness, and pennation angle, as well as deformation of the fascicles. To maintain constant volume, transverse deformation must occur as the fascicles shorten. As shown, transverse deformation of the muscle belly and the fascicles is reduced in the presence of transverse loads, and it is possible that this resists the longitudinal development of force. These results suggest that limitations in muscle deformations are key in reducing maximum twitch force in human muscle.

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THE EFFECT OF WEIGHT BEARING AND KNEE ANGLE ON TENSION OF THE POPLITEUS MUSCLE.

YAGI, M., TATEUCHI, H., KUIRU, M., ICHIHASHI, N.

KYOTO UNIVERSITY

Introduction
It is believed that popliteus can stabilize the knee because the activity increases in slightly knee flexed position in weight bearing conditions (Barnett CH, 1953). However, how the muscle tension of popliteus (MTP) is affected by knee angle in weight bearing condition remains unclear because the measuring method of MTP in vivo has not been established. This study aimed to verify the reliability of MTP, and to investigate effects of knee angle on MTP in weight bearing condition.
Methods
Twelve healthy subjects participated in this study. Passive MTP was measured at 30° knee flexed position as a reference. Additionally, in passive condition, MTP was measured in following three knee angle in prone position: full extension, and 20° external and internal rotation at 30° knee flexion. In isometric contraction condition, following four tasks were performed at 30° knee flexion in prone position: extension, flexion, and external and internal rotation of the knee. In weight bearing condition, subjects performed one-leg standing at 0° and 30° knee flexion. We measured the shear elastic modulus of popliteus (SMP) as an indicator of MTP using ultrasonic shear wave elastography (Aixplorer, Super Sonic Imagine). Intraclass correlation coefficients (ICC) of SMP for each task was calculated. In passive condition, SMP of each task was compared with that in reference. In isometric contraction condition, SMP of each task was compared with that in reference and SMP was also compared between flexion and extension, and external and internal rotation. In weight bearing condition, SMP was compared between 0° and 30° knee flexed position during one-leg standing. Wilcoxon signed rank test with Holm correction was performed for comparison between tasks. Statistical significance was set at 0.05.
Results
ICC1,1 and ICC1,3 for each task were 0.60-0.98 and 0.82-0.99, respectively. In passive condition, SMP in full extension (11.0 kPa) and external rotation (11.5 kPa) were significantly higher than that in reference condition (8.5 kPa). In isometric contraction condition, SMP in flexion (17.0 kPa) and internal rotation (17.2 kPa) were significantly higher than that in reference condition, and SMP in internal rotation was

significantly higher than that in external rotation (8.5 kPa). Then, SMP in 30° flexion (11.7 kPa) was significantly lower than that in 0° flexion (17.7 kPa) in weight bearing condition.
Discussion
The measuring method used in this study had good reliability. The results in passive and isometric contraction conditions showed that functions of popliteus in non-weight bearing conditions were flexion and internal rotation. Moreover, the study showed that MTP decreased with knee flexion in the weight bearing conditions. This suggested that effect of stabilizing the knee by popliteus was decreased in slightly knee flexed position in weight bearing condition.
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Contact
yagi.masahide.54a@st.kyoto-u.ac.jp

Conventional Print Poster

CP-BN02 Sports technology

DEVELOPMENT AND EVALUATION OF A MARKER MODEL FOR KINEMATIC COMPARISON OF THE TENNIS SERVE VELOCITY – A CASE STUDY

VUONG, J., FETT, J., FERRAUTI, A.
RUHR-UNIVERSITY BOCHUM

Introduction
Tennis players and coaches agree, that the serve is one of the most important strokes in tennis. In today's elite tennis the effectiveness of the first Serve is substantially dependent on the post impact ball speed [Girard et al. 2005]. Therefor the aim of this case study was to figure out kinematic differences in the serving motion between a fast and a slow server.
Methods
To identify kinematic parameters of interest for further investigation, two male athletes (Player A: Age 23 yrs, weight 82.0 kg, height 188.5 cm and Player B: 23yrs, weight 63.5 kg, height 178.0 cm) with different service velocities (A 215.6±2.9km/h; B 161.8±1.2km/h) were analyzed via Vicon motion capturing system. A customized mathematical marker model calculated kinematic parameters of the motion. Both players performed 5x8 flat serves as fast as possible. The average parameters of the five fastest serves were used for the comparative analysis. Serve velocity was measured by Stalker Professional Sports Radar.
Results
Conspicuous differences were found in maximum elbow flexion (105.8±1.4°; 80.1±1.2°) and hyperextension of the trunk (-29.4±1.2°; -23.3±0.6°). Both were more expressed for the faster server. At the point of impact the faster server had his wrist still extended, while the slower server was already in a flexed position (14.0±2.6; -4.6±4.7). Furthermore the faster server had notably higher angle velocities in the knee extension of his right leg (695.26±42.5°/s) compared to his left leg (310.5±38.2°/s), while the slower server did not show such a difference (390.9±20.9°/s; 340.4±44.0°/s). Further parameters (e.g. shoulder inclination, jump height, shoulder abduction) showed no obvious differences.
Discussion
The results lead to the assumption, that a greater elbow flexion as well as a greater hyperextension favor a fast serve by leading to more pretension and extending the acceleration distance. The difference in the wrist flexion at ball impact may be a result of the ball toss. The slower server seems to throw the ball too far forward, so that the timing of his wrist flexion is not optimal. Angle velocity differences between the legs of the faster server, point to a shift of the body mass through advancement of the hip and the knees. This motion increases the pretension and could potentially contribute to a higher serve velocity.
The marker model seems to be suitable to capture differences in parameters but needs to be expanded, especially with respect to the upper extremities.
In order to verify the results, the best and the worst servers of the 400 highest ranked young elite players will be analyzed and compared.
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THE APPLICATION OF A KINEMATIC GPS DEVICE TO THE ANALYSIS OF AERODYNAMIC FORCE DURING SKI JUMPING

TSUNODA, K.
HOKUSEI GAKUEN UNIVERSITY

Introduction
In ski jumping, jumper stays in the air after the takeoff. The longer a jumper stays in the air, the longer the flight distance will be (Sasaki et al, 1997). Two mechanical factors, gravity and aerodynamic force, are involved in the flight phase of ski jumping. The aerodynamic force is very important factor. Some methods of measuring the aerodynamic forces in the flight phase exist. The typical method is using high-speed video images. But for video analysis, it takes a lot of time and effort. Today, measurement of position using GPS for sports performance becomes common. The kinematic GPS system is a method for improving accuracy by using reference base station data. The purpose of this study is to apply kinematic GPS device to the analysis of aerodynamic force during ski jumping.
Methods
The 4 university student ski jumpers cooperated with this measurement. Some ski jump performances were recorded at Nayoro jumping hill (HS=100, JAPAN), in Dec. 2016. The jumpers performed ski jumping set a kinematic GPS device (AT-H-02, 78x38x18 mm, 55 g, Tohoku Univ.) on his back. The sampling frequency was 10 Hz. The data obtained from kinematic GPS were converted to latitude, longitude and altitude data. Velocity was obtained by integration of displacement. And acceleration was obtained by second order integration of displacement.
Results and Discussion
The trajectories of ski jumper moved along the profile of jumping hill. In ski jumping, the measurement of height of flight is very important. It was able to obtain enough accurate data to calculate velocity and acceleration. The velocities of ski jumper were increased during

approach run. The maximum velocity was observed at the takeoff edge. The mean of maximum velocity was 22.7 km/h (s.d. 0.5 km/h). During passing of r1, the centrifugal force was observed (approximately 0.1 to 0.6 G). And at the takeoff edge, the reaction force was observed (approximately two times of body weight). When the phase was changed (takeoff phase to flight phase), aerodynamic force was not steady. In flight phase, the velocity decreased at the steady rate. In middle flight phase, the forces acted on jumper are only gravity and aerodynamic force. It becomes possible to calculate the aerodynamic force. The aerodynamic force is able to divided into Drag force and Lift force. In flight phase (after takeoff 1 to 3 sec), the mean drag force was 281.5 N (s.d. 7.4 N) and mean lift force was 317.9 N (s.d. 17.2 N). The weight of the jumper was assumed 75 kg. The result of aerodynamic forces was almost same as our previous studies (using video analysis and using accelerometer).
Conclusions
1) It became possible to measure the trajectory of ski jumper using a kinematic GPS device. 2) The position data was accurate enough to calculate velocity and acceleration. 3) It became possible to calculate aerodynamic force during flight phase.

QUANTIFYING FRONT-CRAWL AND OPEN-WATER SWIMMING STROKES USING THREE INERTIAL SENSORS

BABA, Y., HIROFUMI, S., HIROSHI, I., DAISUKE, S., RIO, N., YUSUKE, I., REIRA, H., YOSHIMITSU, S.
NIIGATA UNIVERSITY OF HEALTH AND WELFARE

Introduction
Open-water swimming races last longer than time than pool-based races, and the waves, tides, winds, and currents associated with oceans make it difficult to assess swimming techniques. These problems can affect evaluations of open-water swimming, particularly the motion of the upper limb. Sensor technology may allow for improved analysis of stroke mechanics and race performance (Mooney et al., 2015). This study aims to use three inertial sensors to quantify open-water swimming and front crawl.
Methods
Three inertial sensors were attached to both wrists and lower back of a trained swimmer. Trials were performed that involved two tests (normal front crawl and ocean swimming with breathing) in a 25-m indoor pool. We used two synchronized cameras (underwater and poolside) to compare with the inertial sensor data. The sampling frequency of the waterproof sensors was 1 kHz. The participant swam at a maximum speed of 30 min before the tests to allow the Critical Stroke Rate (CSR; Franken et al., 2013) to be measured. The swimmer's CSR was then controlled with swimming beepers (Tempo Trainer Pro, Finis®). We estimated the Stroke Rate (Craig and Pendergast, 1979) and considered the definition of the pull phase given by Dadashi et al. (2011). We used the inertial sensors to detect the beginning and end of each pull phase based on the pitch angular speed. We calculated the time interval between two successive peaks, thereby obtaining the mean duration of one whole stroke cycle. The Swimming Velocity and Stroke Length were analyzed using the kinematic video data (Craig & Pendergast, 1979).
Results
The CSR from the 30-min control test was 0.58 ± 0.06 cycles•min−1. We describe the results of two tests as follows: normal front crawl and open-water swimming with breathing. The Stroke Rate was 0.58 ± 0.03 cycles•s−1 and 0.59 ± 0.05 cycles · s−1. The Swimming Velocity was 1.60 m•s−1 and 1.45 m•s−1. The Stroke Length was 2.76 m•cycle−1 and 2.72 m•cycle−1. The Pull phase was 0.21 ± 0.03 (left), 0.18 ± 0.03 (right) s•cycle−1 and 0.10 ± 0.01 (left), 0.05 ± 0.05 (right) s•cycle−1.
Discussion
The participating swimmer could maintain a CSR of 0.58 ± 0.06 cycles•min−1. We were able to estimate the Stroke Rate and Pull phase values from the measured inertial sensor values of both the tests. The Pull phase of open-Water swimming shows a tendency to be shorter than that of front-crawl swimming. Seifert et al. (2005) reported an effect of breathing motion on arm coordination. We speculate that the motion associated with breathing has an effect on the Pull phase. Measurements from inertial sensors can be used to quantify open-water swimming.
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A MODERN INDUCTIVE BASED POOL EDGE WARNING-SYSTEM FOR SAFE TURNS IN PARALYMPIC SWIMMING

WIPPICH, A., CLAUSS, M., STELLING, G., HARTMANN, U.
SPORT SCIENCE AND APPLIED SCIENTIFIC TRAINING

Introduction
Aim was to develop a modern warning-system (IPA-14) which allows visually impaired swimmers to estimate the distance to the pool wall correctly for performing safe turns. The intention is to provide a reliable tool which enables an independent training and alternative to the practiced 'tapping' in competition and training.
Methods
Essential requirements of the system are: limited weight, small / easy to use, reliable. In cooperation with Sportronic-GbR a prototype-I was developed which is based on an inductive principle (1D magnetic field sensor with integrated lithium-ion-battery, low frequency (135 kHz)). When an athlete catches the zone of the transmitter which provides a controlled magnetic field in the swimming lane direction (4m in front of pool wall), a tactile vibration signal (VS; 10000 U/min) is triggered by a sensor at the head of the swimmer (temporal bone anterior). Vibration strength and sensor position data at the head were recorded in several pilot studies. Functionality and switch-on time of the sensor were recorded in several field experiments first with non-disabled persons (n = 12), who carried out a total of 617 turns in different swimming styles. Results were used for evaluation and development of prototype-II which was integrated in a modified head-case and produces a 2 s vibration signal when the alarm level is reached. After that, the system switches automatically into the 'sleep-mode' until next activity signal. Measurements are currently conducted with non- and disabled persons, testing and evaluating prototype-II in terms of functionality, in relation to various speed ranges, swimming styles and subjective perception of the vibration signal respectively and on physical stress.
Results
Practical application test showed that the VS started in 615 of 617 turns correctly (99,7%) which represents a satisfying functionality and correctness. Furthermore, it was observed that the sensor-position at the head is an important influencing factor for the beginning of the VS approaching the transmitter´s zone. At backstroke the signal starts considerably later and less than 5 m in front of the wall (67,7% of

turns, breast stroke: only 26,9%). Also tests suggested that the vibration signal has to be in a quite strong range, especially for fast swimming and in simulated competition.
Dsicussion
The results of the IPA-14 system showed a high reliability to get a valid tactile feedback during swimming with the aim to perform safe turns at different speed levels. Future research has to evaluate the routine application with a greater number of visually impaired swimmers to get more information about the individual feedback and corresponding human-interaction.

EVALUATION OF THE MOTION CHARACTERISTICS OF PERSONAL WATER CRAFT AND EXERCISE STRESS OF RIDER IN JET SPORTS USING ACCELEROMETER AND ELECTROMYOGRAPHY

TOSHIYUKI, O., YUUKI, H., KOUICHI, K., YOSHIHIRO, T.

FACULTY OF ENGINEERING

Introduction
Jet Sports is an aquatic motorsport in which the rider uses a Personal Water Craft (PWC) to compete for first position against other riders around a circular aquatic course. This type of sport using motor-driven machines is different from general sports such as ball sports and athletic sports because factors such as machine specifications, skill controlling the machine and physical fitness of the rider contribute to performance. This study attempted to evaluate the motion of PWC and exercise load of rider in Jet Sports.
Methods
The subjects studied were two riders belonging to either the "pro" or "amateur" sections of the 2017 All Japan Jet Sports Championships. We measured the following 7 parameters while the subjects were riding the PWC around an established aquatic course for 10 rounds. Firstly, acceleration and angular velocity with changes in the machine's motion were evaluated by acceleration and angular velocity sensors at 100Hz. Each activity of seven skeletal muscles including the upper and lower limbs, and body trunk was measured simultaneously by electromyography at 1000Hz. A global positioning system evaluated the riding path and average lap speed for each round. Finally, beats per minute were measured consecutively using a heart rate monitor. At the same time blood lactate concentration was measured at rest before start, at midway point (after 5 rounds) and after the end of riding period.
Results
The PWC's motion was divided into straight and turning phases. The time required for the pro rider to turn the machine was less than that of the amateur. This contributed to a higher average lap speed (51.2 km/h vs. 44.7 km/h) for each round. The pro rider used different muscles according to each phase, whereas the amateur rode by mainly activating the muscles of the lower limbs in both phases. In addition, the average percent of maximum voluntary contraction in each muscle region during each round was roughly higher in the pro rider than in the amateur, except for left lateral great muscle and abdominal muscle. In contrast, the blood lactate acid level of the pro rider was lower than in the amateur at the midway point (3.8 mmol/L vs. 5.0 mmol/L) and finish (3.6 mmol/L vs. 4.1 mmol/L) of the riding period.
Discussion
This study concludes that it is possible that higher skills controlling PWC and muscle endurance ability, especially the buffering capacity of blood lactic acid to maintain speed in both the straight and turning phases.
Contact
Corresponding author: Toshiyuki, O. Chiba Institute of Technology, Narashino, Japan,
E-mail: wpsto@yahoo.co.jp

ASSESSMENT OF SHOULDER FLEXION IN THE SAGITTAL PLANE FOR THE DESIGN OF AN EXOSKELETON

ARGUBI-WOLLESEN, A.1, SCHUBERT, T.2, WOLLESEN, B.2, WEIDNER, R.1, MATTES, K.2

1: HELMUT-SCHMIDT-UNIVERSITY (HAMBURG, GERMANY); 2: UNIVERSITY OF HAMBURG (HAMBURG, GERMANY)

Introduction
The development of assistive devices to support the shoulder girdle, must be based upon knowledge of the underlying strength values (De Looze et al., 2016). However, most research on shoulder strength focuses primarily on the peak values of torque with only insufficient data on torque curve characteristics. Therefore, the goals of this feasibility study were to evaluate and compare the general torque curve characteristics of a maximum shoulder flexion for both genders. The findings are used to create an exoskeleton for upper limb support.
Methods
Using an IsoMed 2000 dynamometer, isokinetic concentric muscle torque for the shoulder flexion in the sagittal plane (arm stretched out) was assessed at 90°/s for N=19 test subjects (women n=12, 29.9±3.0 years, 61.0±4.3kg; men n=7, 28.7±3.6 years, 79.2±3.2 kg, dominant arm only). Subjects remained in an upright seating position and had to complete 2 sets of 5 maximum repetitions per set with 1 min. rest in between. To describe peak torque decline characteristics, the arithmetic means of the torque values of peak torque (pt), 80%(pt) and 50%(pt) and corresponding angles for the middle three repetitions of both sets have been used. To control for gender differences, a one-factor anova was conducted ($p<.05$).
Results
Men created a significant ($F(1,17)=16.82$, $p<.001$, $\eta 2=.497$) higher peak torque (pt=674.5Nm±64.45Nm) throughout the assessed range of motion than women (pt=398.8Nm±169.1Nm). The data showed no significant statistical gender differences (men: 35.8°±10.2°(pt) / 95.6°±32.4°(80%pt) / 149.0°±18.2°(50%pt); women: 35.6°±13.1°(pt) / 102.5°±32.3°(80%pt) / 152.8°±8.2°(50%pt)).
Discussion
The findings are in line with previous studies (Danneskiold-Samsøe et al., 2009) but angles at peak torque differ considerably from optimal ergonomic working positions (Delleman, N. J., & Dul, J., 2007). Based on these findings, support devices only need gender adjustments to the general level of force. Future research has to extend these findings to specialized work and older employees.
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EFFICACY OF A NOVEL SHOE INSOLE ON PLANTAR PRESSURE DURING RUNNING

SUKDOLAK, C., KORNFEIND, P., STAFYLIDIS, S., BACA, A.
UNIVERSITY OF VIENNA

Introduction
There are many concepts to correct deformities of the foot or malfunctions and to reduce involved forces as well as their consequences to the whole musculoskeletal system. Shoe inserts are one of them. They can be roughly divided into two categories: passive bracing (orthotic insoles = OI) (1) and active stimulating (proprioceptive neuromuscular stimulating insoles = PNSI) (2). A novel shoe insole (NI) intends to combine the characteristics of both OI and PNSI inserts. Therefore, the purpose of the present study was to investigate the mechanical properties of the NI compared to the OI and the PNSI during running.
Methods
Five male participants (age: 20.8±1.9, height: 178.0±5.0, weight: 72.2±4.7) without any deficit in their lower limbs ran at 2.3m/s for 30 seconds with the NI, the OI and the PNSI. Plantar force of 25 consecutive steps was measured by an in-shoe pressure measurement system (Pedar-X, Novel) with 100Hz. Peak pressure was evaluated and normalized over the stance phase in 0-100% of all steps. One-way ANOVA with repeated measures was used to determine possible differences between the soles. All significant effects ($p < 0.05$) were followed by Bonferroni post hoc tests.
Results
The NI showed significant (<.01) lower pressure time integral (PTI) than the OI and PNSI (65.2±4.3, 81.3±9.0, 76.3±5.9 kPa·s respectively). The force time integral (FTI) of the NI (287.4±5.6 F·t) was also significant (<.01) lower than the OI (302.9±6.8 F t) but not to the PNSI. The max pressure of the NI was also significant (<.05) lower at 10 % and 40-100 % of the stance phase than the OI and PNSI. At 0% of the stance the NI exhibited reduced max pressure compared to the PNSI but not the OI. On the contrary, at 20-30% of the stance the NI exhibited significant (<.05) higher max pressure than the OI but not the PNSI. At 30% of the stance the NI showed significant (<.05) higher max pressure compared to the PNSI.
Discussion
The NI showed an overall PTI reduction of 20 and 15% compared to OI and PNSI. That could be attributed between 40 to 100% of the stance time. Though at the initial contact phase (0-30%) the NI exhibited relative higher PTI values than OI and PNSI indicating a smaller contact area. This is supported by the smaller surface area (~47, ~54 and ~51cm², NI-OI-PNSI respectively), measured by means of optical scan, at the heel (1/3 of the sole's length) region. In conclusion, it was shown that a combination of the OI and PNSI characteristics in one insole could be functional and promising. Further studies should be conducted in order to assess the effect of the different insoles on the neuromechanics and joint angles of the lower limb.
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Contact
christian.sukdolak@univie.ac.at

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CP-PM02 Strength and power

EFFECT OF 16 WEEKS OF CROSSFIT TRAINING ON BOTH SEX ADULTS MORPHOFUNTIONAL RESPONSE

MARTINS, AP., JOÃO, G.A., CHARRO, M.A., CESCHINI, F., RODRIGUES, D., BOCALINI, D., FIGUEIRA-JUNIOR, A.
SÃO JUDAS TADEU UNIVERSITY

Introduction
The high-intensity training became one of the most studied and practiced physical activities in the world now-a-days. Among contemporary modalities of high-intensity training, it is highlighted the Crossfit®, which is characterized by functional exercises, constantly varied, in high intensity, based on the weightlifting, powerlifting, rowing, running and artistic gymnastics exercises. The purpose of this study was to verify the morphofunctional changes, of experienced adults practitioners of Crossfit® through 6-weeks macrocycle.
Methods
12 both sex subjects (7 men; 30.14 ± 4.14 years old; height 1.79 ± 0.05 m; mean body mass 85.47 ± 12.09 kg and 25.14 ± 16.07 months of Crossfit® practice; 5 women; 29.20 ± 5.22 years old; height 1.64 ± 0.07m; mean body mass 64.46 ± 7.83 kg and 16.60 ± 3.21 months of Crossfit® practice). They performed an 16 weeks periodization (5 times per week, 3 sessions) with weightlifting and powerlifting exercises, (2 twice a week) and variations of gymnastic exercises (Crossfit® specific exercises) without bar. The subjects were submitted to anthropometric, cardiometabolic and and evaluations. The results were analyzed from the ANOVA 1 factor (One-Way) with Post-Hoc Scheffé of repeated measures, Correlation and Effect Sizes.
Results
The data showed that Crossfit® 16-week periodization promoted significant increase of 2.08% ($p < 0.042$) in lean mass (AV1-AV5) and significant decrease of fat mass (16.13%;$p < 0.043$) in AV1-AV3 and 24.84% ($p < 0.002$) in AV1-AV5 respectively. There was a significant increase of 4.52% ($p < 0.042$) in the percentage of lean mass (AV1-AV5) and significant reduction in percent fat (14.32%;$p < 0.005$) and 22.83% ($p < 0.002$) in AV1-AV3 and AV1-AV5 respectively. The data indicated a significant reduction in central adiposity in 16.67% ($p < 0.040$) at AV1-AV3 and 27.03% ($p<0.039$), in AV1-AV5 intervals respectively. We observed a significant increase in VO2max (11.66%, $p < 0.001$) in the AV1-AV5 interval, and significant increase in the sum of the loads of the maximum strength tests (7.39%;$p < 0.015$) in the AV1-AV5 interval. Positive correlations were found from strong to very strong values between maximal strength exercises (r=0.84 to 0.99); moderate to strong between maximal strength x VO2max (r=0.58 to 0.75); weak correlation between maximal force x time of exhaustion (r=0.11 to 0.47); moderate to very strong correlations between maximal strength x circumferences (r=0.67 to 0.92); Weak to strong correlations between relative strength x body composition (r=0.30 to 0.74). The effect size presented trivial results.
Discussion
16 weeks of Crossfit® showed increase in the anthropometric, cardiometabolic and neuromotor variables, and strong correlations values in the analyzed variables.

LONG-TERM RESPONSES TO SHORT REST INTERVALS IN HIGH-LOAD RESISTANCE TRAINING

FUSI, J., GIOVANNELLI, A., CUSPOLICI, T., CERRI, E., BANDUCCI, R., PETROCCHI, A., CARDELLA, G., INNOCENTI, A., GALETTA, F., FRANZONI, F.

UNIVERSITY OF PISA

Introduction
The modulation of rest intervals in resistance training could induce different muscular, hormonal and cardiovascular adaptations. The aim of the present study was to investigate the long-term adaptations induced by short rest intervals in high-load resistance training.
Methods
Ten healthy untrained subjects (age 25.6±4.7 ys) underwent a 3-weekly 2-month high-load (>90% of RM) resistance-training program with short rest intervals between stets (<90 sec) and low recovery time between exercises (<120 sec). Every exercise session was structured in order to train the entire body (bench press, pulley, leg press, curl with dumbbell, french press, hummer curl, hummer curl with relaxation and pull ups) such as to move close to a 'classical' training tab. Body circumferences, strength and hormonal responses were taken in all the subjects before and after the training protocol.
Results
Respect to baseline, training increased arm (28.8±1.8 vs 30.9±1.3 cm, $p<0.05$), thigh (53.3±2.3 vs 55.1±2.2 cm, $p<0.05$) and chest (93.0±2.2 vs 98.1±3.0 cm, $p<0.01$) circumferences, while decreased waist circumference (79.2±3.1 vs 78.0±2.6 cm, $p<0.05$). Strength on RM was increased on bench press (+49.1±10.8%), pulley (+34.8±9.5%) and leg press (+86.4±12.7%) exercises. Blood analyses showed a decrease of testosterone (-5.17%), IGF1 (-5.51%) and cortisol (-3.24%), while DHT (+4.95%) and GH (+54.2%) were increased.
Discussion
The results of the present study showed that a single training program with short rest intervals associated to high-load strength exercises can induce an increase in both muscular mass and strength.

EFFECT OF A STRENGTH TRAINING METHOD CHARACTERIZED BY A DECREMENTAL NUMBER OF REPETITIONS ACROSS SETS AND A VERY SHORT REST INTERVAL

STRAGIER, S.1,2, BAUDRY, S.2, CARPENTIER, A.1, DUCHATEAU, J.2

UNIVERSITÉ LIBRE DE BRUXELLES

Introduction
A recent study (Laurent et al., 2016) indicated that a strength training method (3/7 method) which consists of 5 sets of an incremental number of repetitions during successive sets (from 3 to 7 repetitions), a moderate load (70% of one repetition maximal (1RM)), and very brief rest interval between sets (≤15 s), induced similar increase in maximal strength than a more classical method (8 sets of 6 repetitions with 150s rest interval between sets and identical load; 8x6 method). The present study investigated whether reversing the organisation of the repetitions within sets (decremental; 7/3 method) of the 3/7 method was as efficient as the 8x6 method in strength and muscle mass gains.
Methods
Thirty adults performed either the 7/3 method (n=16) repeated two times within the session or the 8x6 method (n=14), 2 times a week during 12 weeks. The training exercise consisted of lifting and lowering a load (70% 1RM) with the elbow flexor muscles. Maximal strength was assessed as the 1RM and the torque measured during maximal isometric voluntary contraction (MVC). Muscle thickness of the long head of the biceps brachii was recorded by ultrasonography. Neuromuscular fatigability was tested by measuring the maximal number of repetitions performed at a same relative load (70% 1RM). All these variables were measured before and after training.
Results
The MVC torque increased ($p<0.001$) similarly for both training methods (8x6: +11.3%; 7/3: +9.8%). The 1RM increased ($p<0.001$) by 12.9% and 12.5% for the 8x6 and 7/3 method, respectively. The thickness of the biceps brachii increased ($p<0.001$) to a similar extent for both training methods (8x6: +6.1%; 7/3: +7.1%). Regardless of the method, subjects performed less repetitions ($p <0.001$) after than before training (10.4 ± 1.4 vs. 12.4 ± 2.1).
Discussion
The present study indicates that for a similar training volume and intensity, the 7/3 method produced a similar strength gains than a classical method. Surprisingly, the 7/3 method did not reduce neuromuscular fatigability, although such adaptation could be expected as metabolic changes during the training session is likely greater for the 7/3 than the 8x6 method (Penzer et al., 2016). Nonetheless, the main advantage of the 7/3 method is its efficacy as, compared with a conventional method, a similar gain in maximal strength is obtained with a much briefer time to complete the training session.
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IS THERE AN OPTIMAL LOAD FOR FORCE PRODUCTION IN THE STRAIGHT BAR DEADLIFT: FORCE-TIME CHARACTERISTICS IN STRENGTH TRAINED ADULTS

LAWSON, C., MUNDY, P., LYONS, M., DUNCAN, M.

COVENTRY UNIVERSITY

Introduction
The concept of optimal loading during resistance training to develop peak force and maximum muscular power output is regularly cited in the literature (Blatnik et al 2014). However, there is conflict as to the specific load which results in the greatest force and power output, with 'optimal loads' varying from 0-80% of 1-repetition maximum (Turner et al. 2012). To date, no studies have examined peak forces using the deadlift. The aim of this study was therefore to identify if an optimal load for force production and rate of force development (RFD) exists for the straight bar deadlift (DL).
Methods
Following ethics approval, informed consent and familiarisation, 10 strength trained adults (8 males, 2 females, mean age ± S.D. = 24.8 ± 5.8 years), participated in this study. Each participant attended the performance laboratory on two occasions to 1) determine their DL 1RM using methods advocated by Kraemer at al. (2006) and 2) perform 3 DL repetitions at loads of 20-90% of their predetermined individual

1RM . Peak vertical force (PFz) and RFD was determined from the average of the 3 repetitions at each percentage of their 1RM and used for analysis. All data was collected on an AMTI (BP600900, AMTI, Watertown, MA, USA) Force platform.
Results
Repeated measures ANOVA indicated significant differences in PFz across loads of 20-90% 1RM (P = .001) with a linear increase in PFz with increasing % of 1RM. Post-hoc analyses indicated that PFz at 20-40%1RM was not significantly different (P> .05) to each other but was significantly different (P< .05) to every other intensity. PFz at 70-90%1RM was also not significantly different (P> .05) to each other but was significantly higher than 20-60%1RM With respect to RFD, However, there were also no significant differences in RFD across loads of 20-90% 1RM exercise intensities (P > .05).
Discussion
These results suggest that there is no peak in RFD in the straight bar DL. However the results do show an optimal load for maximising vertical peak force production during DL which ranges between 70-90% 1RM. Coaches , may therefore be best placed using this load in the deadlift to maximise force production.
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Contact
email: ac2444@coventry.ac.uk

EFFECT OF POST-ACTIVATION POTENTIATION INDUCED BY ONE, TWO OR THREE HALF-SQUATS ON REPEATED SPRINT ACCELERATION PERFORMANCE

GOEBEL, R.1, ROUISSI, M.2, CHTARA, M.2, CHAMARI, K.3, HADDAD, M.1

1 SPORT SCIENCE PROGRAM, QATAR UNIVERSITY; 2 HIGHER INSTITUTE OF SPORT AND PHYSICAL EDUCATION OF KSAR SAÏD; 3 ATHLETE HEALTH AND PERFORMANCE RESEARCH CENTRE, ASPETAR, QATAR

Introduction
The aim of this study was to analyze the effect of different post-activation potentiation (PAP) protocols on initial-acceleration (0-10 m) and late-acceleration phases (10 to 30 m) within a repeated sprint ability (RSA) test.
Methods
Twenty athletes (age: 20.8±1.2 years, height: 180.2±5.3 cm, body mass: 76.8±6.4 kg, % body fat: 10.9±2.8, and 3 repetition maximum [3-RM] of half-squats 152.9±14.8 kg) completed 4 testing sessions of RSA testing (7x30-m sprints, starting every 25s, with an active recovery in-between). Five minutes before the RSA-testing, conditioning protocols were performed:(i) one half-squats at 90% of 1 repetition maximum (1-RM) [PAP1] (ii) two half-squats at 90% of 1RM [PAP2], (iii) three half-squats at 90% of 1RM [PAP3], and (iv) the control protocol [CON]: no effort. Each conditioning condition was applied in a counterbalanced, randomized order on separate days separated by a minimum of 72 hours' rest.
Results
ANOVA showed that PAP1 and PAP2 sessions were similar, and brought significantly improved results for: 0-30m and 0-10m sprints of the RSA-time ($p<0.001$, ES=large) vs. the PAP3 and CON-conditions. For the late-acceleration phase of the RSA, the conditioning activity gave no effect ($p>0.05$, ES=small). Furthermore, magnitude-based inference revealed that both PAP1 and PAP2 protocols elicited changes >75% likelihood of exceeding the smallest worthwhile change (> 99% likely) for mean sprint-time (RSAmean) and the percentage of sprint-decrement (RSAdec) in overall 0-30m and 0-10m of the RSA test.
Discussion
PAP1 and PAP2 exert a positive effect on the initial-acceleration phase of the RSA and could be considered in the preparation routine of repeated sprinting activities.

THE EFFECTS OF RESISTANCE TRAINING ON SWIMMING PERFORMANCE AND TECHNICAL PARAMETERS

CROWLEY, E., HARRISON, A.J., LYONS, M.

UNIVERSITY OF LIMERICK, IRELAND

Introduction
The majority of propulsive forces in swimming are generated from the upper body with strong correlations (r = 0.93) to sprint swimming performance (Smith et al., 2002). However, there are significant gaps in the literature relating to the transfer of resistance training to swimming performance. The aims of this systematic literature review are (1) to explore the transfer of resistance training modalities to swimming performance and (2) to explore the effects of resistance training on technical parameters of swimming performance including stroke rate and length.
Methods
Four online databases (MEDLINE, PubMed, SPORTDiscus, Web of Science) were searched with the following inclusion criteria: journal articles with outcome measures related to swimming performance and competitive swimmers participating in a structured resistance training programme. Exclusion criteria were as follows: participants with a mean age <16 years, untrained, novice, masters, paraplegic swimmers, triathletes or water polo players, swimmers with injuries or illness and studies focusing on starts and turns specifically.
Results
14 papers were identified, 10 examined dry-land resistance training and 4 examined swim specific resistance training modalities. The dry-land resistance group included biokinetic swim bench, traditional weight training and core training. The swim specific resistance group included resistive band training, arms only training, drag suit training and measurement of active drag system (MAD). Biokinetic swim bench training showed significant improvements in strength but not swimming performance. Traditional weight training showed significant improvements in strength, stroke length and swimming performance. Core training led to significant improvements in strength and swimming performance. Resisted band training showed an increase in stroke rate, strength and swimming performance. Significant improvements were found in arms only and drag suit training but not whole body swimming. MAD showed significant improvements in strength and swimming performance.
Discussion

The current literature shows that resistance training can improve swimming performance. For optimal transfer, low volume high velocity/force resistance training programmes are recommended, with trends in the literature showing an increase in stroke length. Resisted swims provide a viable training modality for increasing stroke rate. For the calculation of stroke rate and length, landmark registration is a reliable and valid method. Long-term intervention studies focusing on both technical parameters and swimming performance are needed as well as full documentation of swimming training and overall periodisation plans. This will help inform trainers, coaches, and athletes alike.

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WHAT IS APPROPRIATE UPPER BODY POWER TEST FOR COMPETITIVE SWIMMERS?

TAKEDA, M.1, NOJIMA, M.1, SASAKI, N.1, NALBANDIAN, M.1, MIMURA, T.2, SHIMAMOTO, H.3, ENDOH, H.4, RADAK, Z.

1: DOSHISHA UNIVERSITY, 2: OSAKA SANGYO UNIVERSITY, 3: OSAKA UNIVERSITY, 4: RYUKYU UNIVERSITY, 5: UNIVERSITY OF PHYSICAL EDUCATION.

Introduction

In competitive swimming, it is recognized that muscle power can predict freestyle swimming performance (Hawley et al., 1992). However, the duration of the swimming race changes widely from 50 m sprint to 1500m distance race. In our knowledge, we do not know the appropriate method for evaluating upper body power that is suitable for different distance swimming performance. In this study, we studied the relationship among 50 m, 100 m and 200 m freestyle swimming performance (swim and pull) and 30 sec., 60 sec., and 120 sec. maximal upper body power performance.

Method

Sixteen male university competitive swimmers (age: 20.0 ± 0.7 years, body weight: 68.4 ±7.3 kg, body height: 175.4 ± 5.9 cm) served as subjects. They were asked to have the time trial in 50 m, 100 m, and 200 m crawl swim (full body) and pull (arm only with both legs fixed using gum band) respectively and maximal upper body power test for 30 sec. 60 sec. and 120 sec. using Ski Ergometer, quite similar upper body exercise mode with swimming, on separate days with 3 days between trials.

In both swimming tests and upper body power test, heart rate (HR) was recorded continuously and blood lactate (La) was measured at pre, post, 3 and 7 minutes later. Swimming time was considered as swimming performance. In upper body test, peak and average power and calculated distance were measured.

Results

Correlational analysis revealed that 50 m swimming performance correlated with 100 m swim (r = 0.77), 200 m swim (r = 0.50), upper body average power for 30 sec. (r = -0.55), calculated distance (r = -0.52), and upper body peak power for 60 sec. (r = -0.53). 100 m swimming performance correlated with 50 m swim (r = 0.77), 200 m swim (r = 0.78), 50 m pull (r = 0.53), and upper body average power for 120 sec. (r = -0.53). 200 m swim performance correlated with 50 m swim (r = 0.50), 100 m swim (r = 0.78), 50 m pull (r = 0.56), and ΔLa from pre to 7 minutes later (r = 0.55).

Discussion

From these results, it was concluded that upper body power test for 30 seconds suitable for estimating the performance of 50 m swimming performance. 120 seconds upper body test could be an appropriate test for 100 m swimming performance. For 200 m (or more) swimming performance, upper body power test for 30 to 120 seconds could not be appropriate.

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DOES DECEIVE STRENGTH TRAINING PRACTITIONERS CAN IMPROVE PERFORMANCE?

MOTOYAMA, Y., ESTEVES, G., GIANONI, R., PEREIRA, P., TEIXEIRA, C., AZEVEDO, P.

FEDERAL UNIVESTY OF SÃO PAULO

Introduction

In sports, coaches use deception as a form of training and expecting better performance when athletes have no knowledge about their training intensities 1. The ergogenic effects of deception can be explained by Noakes and his integrative theory of fatigue 2. However, there are few methodologies using deception with resistance training. The aim of this study was to compare repetitions and rate of perceived exertion (RPE) between tests with difference loads under deception conditions.

Methods

Eight volunteers were recruited and performed 3 sets of bilateral elbow flexion up to concentric failure with 90 seconds resting between sets. All volunteers performed 3 test with different intensities (70%, 80% and 90% of 1 maximum repetition), in different days. To establish load increases, volunteers previously perform 1 repetition maximum test (1RM). To evaluate the RPE, it was used OMNI-RES Scale exactly after last repetition. Deception effect was made with a cardboard protection around the weights plates in each side of the bar. Volunteers did not know about the load changes between days. Descriptive analysis were shown by means and standard deviation (SD) and made through natural logarithm. To compare means ANOVA repeated measures with Bonferroni post-hoc was used with alpha P≤0.05 and Effect Size (based in Hedges'g). Complementary analysis was made through coefficient variation (CV) to standarzing the measure of dispersion and confidence interval (CI) of 95. To practical application, we showed raw data together with data transformed by natural logarithm to repetitions .

Results

Repetitions was different among different loads 70% (6.25±1.59 repetitions; 1.59±0.75 repetitions_log; CV=15%; CI_log=0.67 to 0.83), 80% (4.88±1.75; 0.62±0.17; CV=27%; CI_log=0.50 to 0.74) and 90% (3.13±1.70; 0.40±0.22; CV=55%; CI_log=0.25 to 0.56). Comparing sets, we found value P of 0.002 (70x80%), 0.0001 (70x90%) and 0.001 (80x90%).

RPE had no differences among different loads 70% (6.33±1.59 arbitrary units; CV=25%; CI=5.23 to 7.44); 80% (7.75±0.81; CV=10%; CI=7.19 to 8.31) and 90% (8.25±0.46; CV=5%; CI=7.93 to 8.57). Comparing sets, we found value P of 0.063 (70x80%), 0.053 (70x90%) and 0.359 (80x90%)

Discussion

Our results show no difference in RPE observing through ANOVA, but we can observe a very large ES between 70-80% 1RM and a medium ES between 80-90% 1RM. This data can lead us to highlight that OMNI-RES is not sensible to evaluate changes in strength perfor-

mance in high intensity strength training (<80% 1RM). We conclude that deception does not improve performance when used as an ergogenic strategy in resistance training with deceive loads.
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EFFECT OF BETA-HYDROXY-BETA-METHYLBUTYRATE SUPPLEMENT ON GROWTH HORMONE AND MYOSTATIN RESPONSE FOLLOWING LOW INTENSITY RESISTANCE EXERCISE WITH PARTIAL BLOOD FLOW RESTRICTION

KIM, SH., LEE, J.
DAEGU UNIVERSITY

Introduction
In this study, we investigated the effect of βeta-hydroxy-βeta-methylbutyrate (HMB) uptake and blood flow restriction exercise on muscle strength, blood growth hormone and myostatin concentration.
Methods
A total of 13 young male subjects were selected and classified as HMB-ingested (n = 6) and placebo (n = 7). We measured the pre - maximal muscle strength from all subjects, and performed low - intensity resistance exercise using leg extension operation with 30 min resting pressure applied to HMB or placebo on the day of experiment. After 7 days of rest, pressurizing treatment and HMB intake on maximum muscle strength was evaluated, and plasma growth hormone and serum myostatin levels were measured. Statistical significance was set at $\alpha = .05$.
Results
The concentration of growth hormone following HMB intake and blood flow restriction exercise of low intensity was markedly increased (approximately 3~4 folds) even though statistical significance was not reached (p>.05). This was presumably due to the small sample sizes As we expected, myostatin level was significantly dropped with exercise of low intensity blood flow restriction in the HMB group (p <.05), but not in the placebo group (p>05). Unlike with blood components changes, there were no meaningful alterations observed in maximal muscle strength following all the experimental interventions.
Discussion
These results indicated that HMB ingestion and blood flow restriction induced by blood vessel pressurization exert a at least partial positive role in skeletal muscle synthesis caused by increase of growth hormone and decrease of myostatin level. However, there will be further researches, which elegantly and systematically designed, required to elucidate whether truly skeletal muscle synthesis is occurred after HMB supplementation and blood restriction by pressuring blood vessels, and that could positively correlated with maximum muscle strength and/or power. In subsequent study, the changes of growth hormone and myostatin concentration during the recovery period after blood restriction exercise with combination conditions of HMB intake.

Conventional Print Poster

CP-PM03 Endurance training and testing

THE EFFECT OF TRAINING INTENSITY ON MAXIMAL FAT OXIDATION RATE

ZACHAROGIANNIS, E., PARADISIS, G., MAGOS, S., DAGLI-PAGOTO, F., PILIANIDIS, T., ZACHAROGIANNI, A.
NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

Introduction
The rate of maximal fat utilization (Rfmax) during prolonged submaximal running (50-80%VO2max) can be decisive for the duration of submaximal effort as it may spare the limited CHO reserves. There are, however, no systematically collected data regarding the impact of training intensity on Rfmax metabolism.
Purpose: The aim of this study was to investigate the effect of supramaximal (>100%VO2max) training intensity on Rfmax.
Methods
Forty one (mean ± sd: age, body mass and %fat 25.2 ± 8.5, 76.54 ± 7.61 and 12.2 ± 3.7) trained (100-400m) sprinters and middle distance (800-1500m) runners (SR-MDR) and forty five marathon (MR) runners (mean ± sd: age, body mass and %fat 39.3 ± 8.8, 69.5 ± 7.22 and 12.8 ± 3.9) performed a graded exercise test to exhaustion, with 3-min stages and 1km.h-1 increments in a fasted state (>6 h fasted). Rates of fat oxidation were determined using indirect calorimetry. Weekly training volume 5-10% of the SR-MDRs' consisted of distances run at intensities >107% VO2max whereas MRs' training intensities were <90%VO2max.
Results
No significant differences (p>0.05) were found for the average exercise intensity %VO2max at Rfmax between SR-MDR and MR (mean ± sd, 66.9 ± 8.16 v 64.15 ± 8.68 %VO2max). The range of values of the %VO2max at Rfmax between groups were also comparable: SR-MDR (49.59 - 87.48 %VO2max), MR (49.1 – 89.48 %VO2max). Mean Rfmax was higher (p<0.05) in the MR (0.78 ± 0.24 g.min-1) compared with the SR-MDR (0.64 ± 0.28 g.min-1) group. The values of the Rfmax for the SR-MDR and MR groups ranged from 0.25 – 1.35 and 0.31 – 1.22 g.min-1. Rfmax (g.min-1) Coefficient of Variation was also large for SR-MDR (43.13%) and MR (30.6%).
Discussion
Running training intensities from 60-90% %VO2max induced higher Rfmax possibly through increased insulin sensitivity. When training intensities >107% included in a training program lower Rfmax are expected. Rfmax vary significantly between endurance or sprint trained runners and has to be determined individually.

COMPARISON OF ISOCALORIC ENDURANCE EXERCISE METHODS AND THE IMPACT ON EXCESS POST-EXERCISE OXYGEN CONSUMPTION

HAIBEL, C., RASCHNER, C., STÖGGL., T.

UNIVERSITY OF INNSBRUCK, UNIVERSITY OF SALZBURG

Introduction
Research on isocaloric training is rare. Several studies used external load such as intensity and duration, but not the current total energy expenditure (EE; Cunha et al., 2015). Aim of this study was to compare four endurance training methods – 'high intensity interval training' (HIIT), 'threshold training' (THR), 'sprint interval training' (SIT) and 'long slow distance training' (LSD) - with respect to EPOC, mean power output and total exercise duration (EPOC included) to be isocaloric. Furthermore, the extent to which three HIIT concepts (HIIT 5x4', HIIT 15x1', HIIT 30x30") differ in terms of EE, EPOC and mean power output were analyzed.
Methods
Nine females (26.3±3.8 years, 166±6 cm, 60.6±6.7 kg) and 14 males (31.9±6.3 years, 181±8 cm, 77.4±8.4 kg) completed an incremental test to exhaustion on a cycle ergometer to control the load on the subsequent training sessions. Subjects started in randomized order with one of three HIIT methods, serving as reference for the subsequent isocaloric sessions (THR, SIT, LSD). The remaining two HIIT, THR, SIT and LSD were then completed in randomized order. For all training sessions, EE during exercise and EPOC phase (15 min seated) was measured by indirect calorimetry. ANOVAS with repeated measures were used to examine for differences in total exercise duration, EPOC and mean power output in between the four isocaloric training methods and separately between the three HIIT methods.
Results
For total duration and mean power output to be isocaloric, both HIIT (2088±16 s; 203±54 W) and THR (2061±185 s; 216±65 W) were different ($P<0.05$) from SIT (2628±309 s; 160±65 W) and LSD (3259±521 s; 132±48 W), and SIT was different from LSD ($P<0.05$). During EPOC following HIIT (28±15 kcal) and THR (25±16 kcal) more energy was expended compared with SIT (20±15 kcal) and LSD (16±15 kcal). No differences in EE, EPOC and mean power output were found between the three HIIT concepts.
Discussion
Displaying smaller mean power outputs, both LSD and SIT have to be performed 56% and 26% longer compared with HIIT and THR to be isocaloric. The duration to be isocaloric is probably linked to mean power output during exercise (Wasserman et al., 2005). EPOC was highest during HIIT followed by THR, SIT and LSD. Furthermore, EE and EPOC was not affected by the HIIT concept used (classical interval vs. intermittent HIIT).
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SHORT DURATION OF SPORT SPECIFIC HIGH INTENSITY INTERVAL TRAINING IMPROVED ANAEROBIC PERFORMANCE SIMILAR AS SUPRAMAXIMAL HIGH-INTENSITY INTERVAL TRAINING IN YOUNG MALE ATHLETES

CHAIPATPREECHA, N., MITRANUN, W.

SPORTS AUTHORITY OF THAILAND

Introduction
High-intensity interval training (HIIT) is considered to apply for improving the aerobic and anaerobic capacity. Supramaximal high-intensity interval training (SIT) is the member of the HIIT type which involves shorter time duration of training as compared to ordinary interval training. Sport specific high-intensity interval training (SSIT), our novel training program. The aim of this study was to examine the effects of SIT and SSIT programs on anaerobic capacity in young male athletes.
Methods
Forty-five young male athletes were randomly to control (CON), SIT, and SSIT groups. The SIT program consisted of 10 sets of 3 s of cycle ergometry at 170 % of VO2peak alternated with 30 s of resting periods. The SSIT program consisted of 10 training postures of 30 s alternated with 30 s of resting periods which matched the same energy expenditure and training session. Both groups underwent training 3 times per week for 10 weeks. An anaerobic data was collected before training and repeated after 72 hours of the last training. The data were analyzed using two-way ANOVA with repeated measures. A p-value was set at 0.05 level.
Results
The significant increment of peak power was observed in SIT and SSIT group as compared to pre-test and control group. Mean power increased significantly in both SIT and SSIT as compared to pre-test. A minimum power enhanced significantly in both SIT and SSIT as compared to pre-test and control group. There was no a significant change in fatique index in all groups.
Discussion
The SSIT showed the result in similar as the SIT which performed on a cycle ergometer. The effects of high-intensity interval training were investigated in several studies and appeared to have the better results in many aspects as compared to an ordinary aerobic training in specific population (Mitranun et al., 2014; Wisløff et al., 2007). Short duration of sport specific high-intensity interval training can improved anaerobic performance similar as supramaximal high-intensity interval training on cycle ergometer in young male athletes. With restricted time and applied in practical training, should be recommended as additional program to improve anaerobic performance.
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Contact
Ferguson-top@hotmail.com

EFFECTS OF TWO TYPES OF REPEATED CYCLING SPRINT TRAINING IN HYPOXIA ON SEA LEVEL RUNNING AND CYCLING PERFORMANCE

GATTERER, H.1, MENZ, V.1, SALAZAR-MARTÍNEZ, E.2, STRAUB, S.1, NIRRNHEIM, JM.1, BURTSCHER, M.1
UNIVERSITY INNSBRUCK

Introduction
In recent years repeated sprint training and sprint interval training in hypoxia have emerged as popular and effective training modalities. Yet, literature on the benefits for sea level performance is controversial (Montero et al. 2015). One reason for these contrasting findings might be the use of different sprinting protocols. Furthermore, it is not well established whether a transfer training effect (cycling training vs. running performance outcomes) exists for this type of training. This study aimed to investigate the effects of a hypoxia training program including short and long duration repeated maximal cycling sprints on running and cycling performance outcomes.
Methods
Eleven athletes participating in intermittent sports performed either a short (n=5, 3 times 5 x 10s bouts with 20s and 5 min recovery between repetitions and sets, respectively) or long (n=6, 4 times 30s bouts with 4 min recovery) duration repeated sprint training program at a simulated altitude of 2200m. The training lasted for 3 weeks and included 3 sessions per week. Before and after the training a Wingate anaerobic test, a repeated cycling sprint test (5 x 6s with 20s recovery) a Yo-Yo intermittent recovery test (YYIR level 2) and a repeated running sprint test (RSA, 6 x 17 m back and forth with 20s recovery) were performed.
Results
Mean power output during the Wingate test (long: +31.9±47.4 and short: +62.0±38.9 watts) and the repeated cycling sprint test (long: +55.5±44.9 and short: +91.8±58.1 watts) improved over time (ANOVA, $p=0.006$, $eta^2=0.592$ and $p<0.001$, $eta^2=0.703$, respectively) without interaction effect ($p=0.277$, $eta^2=0.130$ and 0.283, $eta^2=0.126$, respectively). Similarly, the running test outcomes improved over time (YYIR test: long: +100.0±51.6 and short: 96.7±145.6m ($p=0.034$, $eta^2=0.449$); RSA: long: -0.107±0.08 and short: -0.138±0.14s ($p=0.012$, $eta^2=0.564$)) without interaction effect ($p=0.967$, $eta^2<0.001$ and 0.700, $eta^2=0.020$, respectively).
Discussion
The present data show that hypoxia cycling training including either long or short duration repeated sprints improves sea level cycling as well as running performance to a similar extent. The latter finding is in agreement to Hamlin et al. (2017) who showed that "off-feet" repeat sprint cycling is beneficial for "on-feet" RSA in amateur rugby players. Therefore, such training may be recommended to vary training loads in intermittent sports where heavy on-feet training strain has to be accomplished.
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STEP DURATION, LACTATE PERFORMANCE CURVE AND LACTATE THRESHOLDS IN TREADMILL RUNNING

KRÄMER, K., NIEMAND, M., SCHEER, V., HEITKAMP, H.C.
UNIVERSITY OF PADERBORN

Introduction
Step duration is important for detecting lactate thresholds and the corresponding heart rate for training guidance. The aim of the study was to determine the influence of step duration on lactate threshold (LT), individual anaerobic threshold (IAS) (Dickhuth) and on the fixed thresholds of 2 mmol/l and 4 mmol/l (Mader) in endurance trained runners.
Methods
A group of 14 endurance trained men (25±5 years, VO2max 57 ml*kg -1*min -1) participated and completed two different step protocols (3 min vs 5 min steps) on the treadmill within 2 weeks for lactate diagnostic purposes, heart rate and VO2max measurements. Subsequently a maximum lactate steady state test over 0.5 hours was performed in 8 runners.
Results
Speed at LT was very similar: 10.6 ±0.8 and 10.7±1.1 (n.s.), but not the speed at the 2mmol/l threshold: 14.4±1.5 and 13.9±1.7 km/h ($p<0.05$), and at the IAS 15.0±1.2 and 14.4±1.3 and at the 4 mmol/l threshold 16.4±1.4 and 15.6±1.4 km/h. The difference between the speed at the LT and 2mmol/l and IAS and 4mmol/l was significant, ($p<0.05$). The corresponding heart rates were the following: at the LT 141±11/min and 144±11/min and at the 2 mmol/l threshold 168±8/min and 169±8/ min , at the IAS 173±8/min and 172±8/min and at the 4 mmol/l threshold 181±8/min and 179±7/min. Thus, the IAS is closer to the 2 mmol/l threshold than to the 4mmol/l. Eight of the runners then completed a maximum lactate steady test at the speed of the IAS for 0.5 hours and we found that seven of those athletes were close to the steady state at their IAS speed, thus validating the IAS threshold.
Discussion
Lactate performance diagnostics for training guidance should be done with 3 minute step durations and the LT and IAS used for endurance trained men.

A COMPARISON OF THE PHYSIOLOGICAL STRESS IN A MULTI STAGE STEP TEST WITH TWO DIFFERENT EXERCISE PROTOCOLS

BAUMGÄRTEL, L., SCHULZ, H.
TECHNISCHE UNIVERSITÄT CHEMNITZ

Introduction
Step tests are a simple and cost-effective method for determining cardiorespiratory performance. Increasing the exercise load in multi stage step tests is usually carried out by increasing the stepping frequency. Changing the stepping frequency, however, can be a problem for certain target groups. The aim of this study was therefore to examine whether an increase by the step height, representing the same physical performance, leads to similar physiological responses in the body.
Methods
19 healthy volunteers (23 ± 3 years, 180 ± 8 cm, 79 ± 15 kg) underwent two different step test protocols, in a randomized order with six stages. In protocol 1 (P1), the step height was constant at 25 cm. The load was increased by the climbing frequency (5 steps per minute

(spm), every two minutes, from 10 to 35 spm). In protocol 2 (P2), the load was increased by the step height (5 cm, every two minutes, from 10 to 35 cm) at a constant stepping frequency of 25 spm. Heart rate (HR), oxygen uptake (VO2), blood lactate (La) and evaluation of perceived exertion (RPE) was recorded before (TRest), at the end of each stage (T1 - T6) and three minutes afterwards (TRecovery). For comparison of the differences, the root mean square error (RMSE) was calculated (Atkinson & Nevill 1998).
Results
Between the protocols, higher values were measured in P1. The RMSE of the HR differed from 4.8 to 7.3 bpm independently of measuring time point. The lowest deviation of La was found in T2 - T4 (0.13 mmol/l), the highest differences were found in TRest, T1, T5, T6 and TRecovery with up to 0.71 mmol/l. The VO2 differs about 0.8-2.7 ml/min/kg, with the highest amount in T5 and T6. RPE was significantly higher at T5 and T6 in P1 (Wilcoxon $p < 0.05$).
Discussion
Despite the same calculated physical performance of P1 and P2, there are differences in the physiological stress between the two protocols. The measured differences are higher than the expected day by day variations in step tests (Bennett et al., 2016). To estimate the maximum oxygen uptake in multi stage step tests, the linear relationship between workload, submaximal exercise HR and VO2 based on the ACSM's stair-stepping equation is used (ACSM, 2014; Sykes et al., 2004). Considering the differences in HR between the protocols, an adaptation of the maximum oxygen uptake estimation could be necessary. Despite the modest differences in the protocols both are suitable for practical application.
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Contact
lutz.baumgaertel@hsw.tu-chemnitz.de

COMPARISON OF THREE DIFFERENT EXERCISE TEST PROTOCOLS FOR TRAIL RUNNERS

RAMME, K., HEITKAMP, H.C., SCHEER, V.

UNIVERSITY OF PADERBORN

Introduction
Running is a popular sport with increasing participation over the last few decades. A new discipline- trail running- has emerged recently where most of the running takes place off road and in mountainous areas. The physical demands on the human body vary quite significantly compared to level ground running and standard exercise test protocols often do not take this into account especially in competitive athletes. Therefore we compared a newly designed trail test exercise protocol with increasing gradient and speed to reflect their training and competitive demands to two standard exercise test protocols in trail runners.
Methods
We performed three different exercise test protocols in randomized order until exhaustion. All tests started with a standardized warm up programme of 3 min at 8km/h followed by: step test: 8 km/h, increment 2 km/h, duration 3min; ramp test: 10km/h with continuous increments of 1km/h per minute; trail test: 10km/h with continuous increments of 0.5 km/h per minute and continuous increments of gradient by 1% per minute. Measurements of VO2max, heart rate, capillary blood lactate, test duration and a subjective assessment of exhaustion (Borg scale) and test preference were performed.
Results
Six moderately trained male trail runners participated in the study and completed the three different exercise test protocols (age 31.8±6.8 years, BMI 22±1.6 kg/m2, weekly training load 72±26.2 km). The values for the step test vs ramp test vs trail test were the following for: VO2max 60.3± 6.4 ml*kg -1*min -1 vs 61.2±6.5 ml*kg-1*min-1 vs 61.5±7.6 ml*kg-1*min-1; heart rate 181.7±12.6/min vs 184.7±11.5/min vs 181.5±9.1/min; maximum blood lactate values at 3 min post test 9.6±2.8 mmol/l vs 8.3±1.5 mmol/l vs 9.9±2.1 mmol/l; test duration 1464±191 sec vs 689±134 sec vs 621±84 sec; Borg scale 18.8±1.5 vs 19±0.7 vs 17.8±1.2; test preference: step and trail test each 43% and ramp test 14%.
Discussion
The three different exercise test protocols that were evaluated showed similar levels for V02max, heart rate, lactate levels and perceived exhaustion. The test duration was considerably shorter for the ramp and trail test protocol compared to the step test protocol. Trail runners had a subjective preference for the trail and step test compared to the ramp test. The trail test is a suitable test for trail runners especially considering test duration economy and athletes preference while obtaining physiological data comparable to standardized tests.

VALIDITY AND RELIABILITY OF THE MODIFIED SHUTTLE WALK TEST IN OLDER ADULTS

HORTON, E., HAMES, T., LOWTON-SMITH, S., DUNCAN, M.J., LEDDINGTON WRIGHT, S.

COVENTRY UNIVERSITY

Introduction
Exercise performance tests are an important method to prescribe exercise for older adults and can be used to stratify associated risk (ACSM 2014). Common testing protocols are often not appropriate for older adults (Huggett et al. 2005) or outcomes influenced by testing procedure (Beekman et al. 2013). The modified shuttle walk test (MSWT) is an externally paced progressive walk test which is validated in clinical populations and may be suitable for older adults. The aim of this study was to provide evidence on the reproducibility and validity of the MSWT in a group of older adults.
Methods
Following ethics approval and informed consent, 22 participants (10 males; mean±SD age 65±6 years) completed a symptom limited VO2peak treadmill test using the modified Balke protocol. After a 30 minute rest period a MSWT was completed. A week later participants completed two further MSWTs with 30 minutes rest periods in-between. Heart rate (HR) was monitored throughout each of the tests.
Results
VO2peak was 27.4±7.0 ml.kg.min, MSWT distance for test 1 584.9±194.3m test 2 629±137.6m and test 3 652±144.2m. There was a significant relation between the results of the three MSWTs and VO2peak (r=0.78, r=0.67 and r= 0.59 for tests 1-3 respectively). Peak HR achieved in each of the MSWTs also significantly correlated with peak HR during the VO2peak test (r= 0.61, r=0.69 and r=0.52 for tests 1-3

respectively). There was no statistically significant difference between distance walked in the three MSWTs or peak HRs. The mean difference between test 1 and 2 was 41m (95% confidence interval; CI -105 to 24) compared with 23m (95% CI -53 to 6) between tests 2 and three. The reliability of the repeated measures (intra class correlation coefficient; ICC) was 0.87 (95% CI 0.69 to 0.95) between test 1 and test 2 and 0.96 (0.90 to 0.99) between test 2 and 3.
Discussion
This study suggests that the MSWT is a valid and reliable measure of exercise capacity in older adults. However, the magnitude of this association became less as the number of tests increased. Collectively, the results demonstrate the MSWT is reliable and valid, but there may be a learning effect with the MSWT. In order to account for this in research studies, scientists and clinicians should ensure participants have at least 1 practice trial before experimental data is used.
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CP-PM08 Energy metabolism

THE EFFECT OF RUNNING SPEED IMMEDIATELY BEFORE SPEED UP ON OXYGEN UPTAKE KINETICS DURING SUBSEQUENT HEAVY INTENSITY RUNNING

MIGITA, T.
KURUME UNIVERSITY

Introduction
Numerous studies show that the prior exercise accelerates oxygen uptake kinetics during subsequent exercise. In order to clarify the effect of warm-up, exercise model in previous studies has rest and/or low-intensity exercise (e.g. unloading pedaling) between prior and subsequent exercise. During long distance race, abrupt getting up running speed forces runner suddenly to demand energy. The aim of this study was to determine whether running speed immediately before speed up affected the oxygen uptake kinetics during subsequent high-intensity running.
Methods
Eight healthy male volunteers (mean±SD: age:19.6±1.4 yr ; height: 169.3±4.9 cm ; weight: 67.9±7.39 kg) performed a velocity-incremental maximal and two transient submaximal running tests. From the results of maximal test, running velocity corresponded to ventilation threshold (VT) and maximal oxygen uptake (VO2peak) was estimated. Subjects performed two 12 min continues running tests, which were consist of 1st stage (6 min) and 2nd stage (6 min). The 1st stage running was velocity corresponding to either 80%VT (sub-1) or VT (sub-2). The 2nd stage running during both tests (sub-1, sub-2) was velocity corresponding to ⊿40% (VT + (VO2peak – VT)×0.4). Pulmonary gas exchange parameters were measured during all exercise tests. During transient running tests, non-linear regression technique was used to fit the 6 min of VO2 for 1st and 2nd running respectively. The oxygenation status of the vastus lateralis muscle of the left leg was monitored using a commercially available near infrared spectroscopy (NIRS) system and Surface electromyogram (EMG) was obtained from the vastus lateralis muscle of the right leg during submaximal tests.
Results
During 2nd stage, VO2 for primary phase were 3072.8±516.0 ml/min (VO2 base: 2063, amplitude: 1009) (sub-1) and 3195.6±492.8 ml/min (VO2 base: 2739, amplitude: 457) (sub-2), there was no significant difference. Time constant of VO2 response in primary phase was significantly longer during sub-2 compared to sub-1 ($p < 0.05$). Amplitudes of slow component were 173.0±103.2 (sub-1) and 178.4±154.1 (sub-2). No significant difference in the slow component results from large interindividual difference rather than the same values between sub-1 and sub-2. NIRS-derived deoxygenated hemoglobin during both submaximal tests were alike, which results in greater in 2nd stage compared to 1st stage. Integral values of EMG signal was almost constant throughout both submaximal tests.
Conclusion
These results suggest that the difference of running speed immediately before speed up affects oxygen uptake kinetic velocity during subsequent running, and slow component itself was affected by individual ability against heavy intensity exercise.

EFFECTS OF SPRINT INTERVAL TRAINING COMBINED WITH INSPIRATORY MUSCLE RECOVERY ON AEROBIC CAPACITY AND EXERCISE TOLERANCE

CHENG, C.F.1, HSU, W.C.2, LIN, Y.S.3, DING, C.H.1, LIU, C.T.3, CHEN, T.W.1, LEE, C.L.4
1: NATIONAL TAIWAN NORMAL UNIVERSITY (TAIPEI, TAIWAN), 2: UNIVERSITY OF TAIPEI (TAIPEI, TAIWAN), 3: NATIONAL TAIWAN NORMAL UNIVERSITY (TAIPEI, TAIWAN), 4: NATIONAL SUN YAT-SEN UNIVERSITY (KAOHSIUNG, T

Introduction
During sprint interval training (SIT), muscle contraction at the last sprints might be compromised by metabolic acidosis. Our previous study [2] found that inspiratory muscle active recovery (IMR) performed at rest intervals during sprint interval exercise could attenuate the lactate (La) accumulation and drop in pH. This study further examines the chronic effects of SIT combined with IMR (SIT+IMR) on aerobic capacity and performance in athletes.
Methods
Thirty-three collegiate male athletes were randomly assigned to SIT+IMR, SIT, or control (CON) group. Both SIT+IMR and SIT performed 6 sets of 30-s cycling sprint with 5-min rest interval (3 times/week), whereas the CON did not perform any SIT. At 5-min rest intervals, IMR (15 cmH2O) and placebo (0 cmH2O) were respectively administered in SIT+IMR and SIT. Before and after 4-wk intervention, participants performed the graded exercise test (GXT), moderate [MI: 80% of ventilatory threshold (VT) for 6 min] and severe [SI: VT plus 60% of differences between VT and maximal oxygen uptake (VO2max) until exhaustion] intensity exercise tests on a cycling ergometer. Pulmonary gas exchange and ventilation (VE) were measured during the exercise tests. The blood La and pH were assessed before and after the exercise tests.
Results

VO2max (SIT+IMR: +5.3%; SIT: +4.8%), maximal work rate (SIT+IMR: +5.6%; SIT: +6.3%), and time to exhaustion (SIT+IMR: +4.3%; SIT: +4.9%) during GXT were significantly increased in SIT+IMR and SIT, but no changes in CON. The VE/VO2 and VE/VCO2 at post-training in SIT+IMR and SIT were significantly lower than that in CON during MI exercise. No significant interaction effects in the VO2, VE, VE/VO2, VE/VCO2, and time to exhaustion were found during SI exercise. However, the La after SI exercise at post-training in SIT+IMR was significantly decreased ($P < 0.05$), and was significantly lower than those in SIT and CON ($P < 0.05$). The pH after SI exercise at post-training in SIT+IMR was significantly higher than that in CON (7.26 ± 0.06 vs. 7.21 ± 0.04, $P < 0.05$).

Discussion

SIT has been reported to improve the metabolic function and aerobic performance of athletes [1]. This study provided a support for the improvements in aerobic capacity by SIT in well-trained athletes. This present study was the first to determine that SIT+IMR might attenuate the metabolic acidosis during SI exercise. The high oxidative capacity of respiratory muscles make them suited to act as La consumers during and after exercise [3, 4]. Strength and conditioning professionals are encouraged to add IMR to SIT for enhancing the buffering capacity during intense exercise.

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Contact

andescheng@ntnu.edu.tw

EFFECT OF HYPEROXIA ON STATIC MUSCULAR ENDURANCE

KOJIMA, Y., FUKUSAKI, C., ISHII, N.

THE UNIVERSITY OF TOKYO

Introduction

We previously reported that hyperoxic condition can enhance dynamic muscular endurance, whereas its effect on static muscular endurance has not been well understood. This study aimed to investigate the effects of hyperoxia on static muscular endurance.

Methods

Eight healthy young men performed one-hand isometric elbow flexion until exhaustion at an intensity of 30% of maximal voluntary contraction (MVC) in two separate occasions: one was under normoxic condition (20.9%O2; NOX) and the other was under hyperoxic condition (30.0%O2; HOX). Each session was conducted on a different day in randomized order. Electromyographic activity (EMG) and oxygenation level of the biceps brachii muscle were measured during exercise with surface electrodes and near-infrared spectroscopy (NIRS), respectively. Root mean square (RMS) of EMG was normalized to that at MVC. Changes in oxygenated (⊿O2Hb), deoxygenated (⊿HHb), and total hemoglobin levels (⊿cHb) from those at rest, and tissue oxygenation index (TOI) were analyzed. In each condition (NOX or HOX), the mean values of these indices throughout the exercise duration until exhaustion (total exercise duration) and for the first, middle, and last ten seconds of total duration were calculated. Values of total exercise duration in HOX and NOX were compared with a paired t-test. Two-way analysis of variance (ANOVA) was performed to test oxygen concentration effect (HOX and NOX) and time effect (first, middle, and last of total duration). The correlation between indices for tissue oxygenation level and total exercise duration was examined with Pearson product-moment correlation coefficient. $P<0.05$ was considered significant.

Results

Although a significant difference was not seen, there was a large individual difference in the magnitude of change in the total exercise duration between HOX and NOX. Two-way ANOVA showed significant time effects, but no significant oxygen concentration effect and interaction for all of indices representing muscle electrical activity and tissue oxygenation. Mean values of these indices for total exercise duration did not show significant differences between HOX and NOX. However, the magnitude of change in total exercise duration between HOX and NOX showed positive correlations between ⊿O2Hb ($r=0.86$, $p<0.01$) and ⊿cHb ($r=0.80$,$p<0.01$).

Discussion

These results indicate that there is a large individual difference in the effect of hyperoxic condition on static muscular endurance, probably depending on blood flow and muscle oxygenation in working muscle in hyperoxia. Individual difference in vasoconstriction under hyperoxic condition (Welch et al., 1977) and/or the magnitude of increase in intra-muscular pressure at 30% MVC may be related.

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Contact

d157616@h.k.u-tokyo.ac.jp

VO2PEAK DURING DECREMENTAL LOAD EXERCISE: A COMPARISON OF DIFFERENT RATES OF DECREASE IN LOAD

PATTISON, J., NATALIE, C.

ST MARY'S UNIVERSITY

Introduction

Maximal oxygen uptake (VO2max) is generally accepted as the best measure of cardiorespiratory fitness and is therefore used to outline the magnitude of adaptation that occurs in response to exercise training and detraining. However, as measures of VO2max are partially reflected by the protocol modality and the analysis of gas exchange data, researchers have tried to identify the most efficient and reliable procedure to measure VO2max. The aim of this study was to investigate the effects of different decrements in treadmill speed on peak oxygen uptake (VO2peak) using decremental workloads and compare values against those achieved on an incremental test.

Methods

Eight physically active participants (4 male and 4 female); age, height and body mass of the participants were: 21 ± 1 years, 175.00 ± 9.81 cm, 72.99 ± 12.83 kg, respectively (mean ± standard deviation). Five separate maximal intensity exercise tests on a motorised treadmill were completed. Trial 1 required participant's to complete an incremental exercise test at increments of 1 km·h-1 every 60 s (equivalent to one stage) with a constant treadmill gradient of 5% until participants were unable to continue. Participants then remained on the treadmill at 10 km·h-1 and 5% inclination for 60 s, followed by 13 km·h-1 for 30 s. Treadmill speed was then increased to 1 km·h-1 higher than the last stage completed by the participant during trial 1. Trial 2 was used to confirm VO2peak. Following a randomised crossover design,

trials 3, 4 and 5 required participants to conduct separate decremental exercise tests, consisting an initial bout of exercise at supramaximal load, followed by decrements in speed of either 0.2 km·h-1, 0.5 km·h-1, and 0.8 km·h-1, every 30 s, 30 s, 45 s, 60 s, 90 s and 120 s, respectively, until exhaustion. Respiratory measures were collected from expired air (breath-by-breath) with the Cosmed K4b2 portable metabolic analyser.
Results
A repeated measures ANOVA revealed that there was no significant difference in VO2peak ($F(4, 28) = 0.577$, $p > 0.05$) between trial 1 (52.31 ± 5.71ml·kg·min¬-1), trial 2 (51.67 ± 4.63 ml·kg·min¬-1), trial 3 (52.00 ± 6.48 ml·kg·min¬-1), trial 4 (53.28 ± 6.07 ml·kg·min¬-1), or trial 5 (53.32 ± 6.75 ml·kg·min¬-1). There was a significant difference in TTE ($F(3, 21) = 36.024$, $p < 0.05$), with post hoc analyses revealing a significantly lower TTE in trials 3, 4, and 5, compared to trial 1 ($p < 0.05$).
Discussion
The similarity in VO2peak throughout all experimental trials indicates that VO2peak cannot be exceeded regardless of size of increment or decrement speed. A second important finding from the present study was that the participants achieved VO2peak at around ~50% of the TTE achieved in the incremental protocol.
Cintact
john.pattison@stmarys.ac.uk

ACUTE HIGH-INTENSITY INTERVAL EXERCISE ENHANCES FAT OXIDATION AND ATTENUATES POSTPRANDIAL INSULIN CONCENTRATION IN HEALTHY MEN

LEE, C.L.1, CHENG, C.F.2, KUO, Y.H.3

1: NATIONAL SUN YAT-SEN UNIVERSITY (KAOHSIUNG, TAIWAN), 2: NATIONAL TAIWAN NORMAL UNIVERSITY (TAIPEI, TAIWAN), 3: NATIONAL TAIWAN NORMAL UNIVERSITY (TAIPEI, TAIWAN)

Introduction
The postprandial lipemia has gained popularity in recent years as a risk for atherosclerosis [1] and cardiovascular disease [2] in adults. The high-intensity interval exercise with time-saving and low volume character has been reported to improve postprandial lipemia [3] and fat oxidation [4]; however, the effects of sprint interval exercise (SIE) is unclear. This study examines the effects of SIE on carbohydrate and fat oxidation, and physiological responses.
Methods
Thirty-six active healthy males were randomly assigned to a SIE group (SIG), ten 60-s sprints at 85% of VO2max with a 120-s resting interval between sprints; a moderate-intensity exercise group (MIG), exercising at 65% of VO2max for 50-min, and a non-exercising control group (CG). The next morning after exercising, participants reported to the laboratory after a 12 hr fast and a baseline blood sample was obtained, and the participant then ate the test meal according to body mass (1.1 g fat, 1 g carbohydrate, and 0.3 g protein). Further blood samples were obtained 1 hr after completion of the meal and then hourly until 4 hr. Pulmonary gas exchange was measured during exercise, before and after the meal to determine the carbohydrate/fat oxidation rates.
Results
The improved fat oxidation over 1th hr (SIG vs. MIG vs. CG: 4.6 vs. 2.9 vs. 2.6 kJ/min, $P < 0.01$) and 2nd hr (SIG vs. CG: 4.6 vs. 3.5 kJ/min, $P < 0.05$) during postprandial rest in response to SIG was found; yet the carbohydrate oxidation was not significantly different among groups ($P > 0.05$). Immediately after exercise, SIG had a higher glucose concentration and MIG had a lower glucose concentration while comparing with CG ($P < 0.01$). Insulin concentration decreased after exercise in response to MIG, and attenuated during fast and postprandial rest in response to SIG ($P < 0.05$). No difference in triglyceride concentration was found among three groups ($P = 0.08$).
Discussion
Studies revealed that all-out sprints is an effective mode of exercise to reduce fasted and postprandial triglyceride concentrations in metabolic syndrome [5] but not in healthy men [3]. Although triglyceride did not change in response to SIG and MIG, insulin concentration in SIG was markedly decreased by 33% and 40% before and 3 hr after a high-fat meal than CG and MIG, respectively. Our finding was in line with a previous study [4] who found postprandial fat oxidation was higher in high-intensity exercise than in moderate intensity exercise. We concluded that acute SIE in the evening was better than moderate-intensity exercise for attenuating insulin level and increasing postprandial fat oxidation in the next morning.
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Contact
karenlee1129@gmail.com

ENERGY EXPENDITURE IN YOUNG CHILDREN DURING ACTIVE VIRTUAL REALITY SOCCER PLAY

LEE, D.T.1, LEE, Y.B.2, YUN, S.2, JUNG, M.G.2, KWON, I.J.3, LIM, D.3, PARK, C.H.3, LIM, C.H.4, CHA, H.J.4, GUK, J.P.4

KOOKMIN UNIV., AIRPASS COMPANY

Introduction
Physical inactivity and overweight in children are recognized as a fast-growing global epidemic, and various countermeasures have been proposed to promote physical activity. Recently, active video games have been introduced and have proven to be comparable to light-to-moderate physical activity (1). This study evaluated energy expenditure (EE) in elementary school children engaged in physically active virtual reality soccer play (VRS) and compared their EE to that during a regular physical education class (GYM).
Methods
In total, 70 school children from 4th–6th grades (11.8 ± 0.8 years, 146.1 ± 7.2 cm, 40.0 ± 9.9 kg) were enrolled and all of them participated in two class sessions; one for VRS and one for GYM. Each class lasted 40 min. In VRS, they set up, kicked, and threw soccer balls against a screen wall, which showed simulated soccer fields and players. A computer system could locate the balls, and the screen showed the balls and player responses to them. In GYM, they played in a gymnasium while a teacher directed several games. During all the classes, their bodily movements were continuously recorded by video cameras. The recordings were segmented by movement characteristics,

which were properly matched with Metabolic Equivalent of Task (MET) intensities (2). The EE of each segmented movement as well as of the total class were calculated accordingly. One-way ANOVA with repeated measures and independent t-test were employed for comparisons.
Results
EE was significantly higher in GYM (2.8 ± 0.7 kcal/min or 166.3 ± 39.7 kcal/h) than in VRS (2.3 ± 0.6 or 140.1 ± 34.1) ($p < 0.001$). The 5th (2.5 ± 0.4 kcal/min) and 6th (2.7 ± 0.6) graders showed greater EE than the 4th (2.1 ± 0.5) graders in VRS ($p < 0.01$). In GYM, the age groups ranked by the descending order of EE were 6th (3.1 ± 0.8 kcal/min), 5th (2.7 ± 0.4), and 4th (2.6 ± 0.7) graders but it was only different between the 4th and 6th graders ($p < 0.05$). The average METs were 4.17 ± 0.24 in GYM and 3.51 ± 0.04 in VRS ($p < 0.05$). METs of VRS were equivalent to 84.3 ± 4.6% of those in GYM.
Discussion
VRS may have the potential to increase EE in those who are not physically active. VRS may also be a substitute for a regular physical education class while requiring an energy cost of 3–4 METs. If school children spend considerable playing time in playing virtual reality screen games, they may gain minimal benefit of EE. Thus, VRS seems to be a safe and motivating means of promoting EE.
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Contact
dtlee@kookmin.ac.kr

CHANGES IN ENERGY COST AND MECHANICAL WORK DURING WALKING IN ELDERLY AND YOUNG SUBJECTS, OBSERVED AFTER BED REST AND FOLLOWING PHYSICAL TRAINING

FLOREANI, M.1, TABOGA, P.1, REJC, E.1, PIŠOT, R.2, ŠIMUNIČ, B.2, BIOLO, G.3, REGGIANI, C.4, PASSARO, A.5, NARICI, M.6, DI PRAMPERO, P.E.1, LAZZER, S.1

1:DMA(UDINE,ITALY), 2:IKRSRC(KOPER,SLOVENIA), 3:DMSHS(TRIESTE,ITALY), 4:DBS(PADOVA,ITALY), 5:DMS-SICM(FERRARA,ITALY), 6: MRC/ARUK-CMAR(DERBY,UNITED KINGDOM)

Introduction
Physical inactivity and/or bed rest (BR) have several negative effects especially on the musculoskeletal system leading to dramatic reduction in the ability to produce force which is one of the most important requirements to perform everyday tasks. Elderly people are particularly vulnerable to any acute loss in muscle function mainly because of sarcopenia. We therefore want to investigate: 1) the effects of bed rest and a following training program on the energy cost (CW), mechanical work and efficiency (EFF) during walking in young and elderly people; 2) the reasons why elderly (E) individuals have an higher CW than young (Y) ones.
Methods
Twenty-three healthy male subjects (E: n=16, 59.6±3.4 years; Y: n=7, 23.1±2.9 years) participated in this study. The subjects spent 14 days of BR without any physical exercise and/or other countermeasures after which they underwent to a 14 days of physical training (PT). CW, mechanical work, EFF and co-contraction time (at the level of thigh and ankle) were measured during walking at 0.83, 1.11, 1.39, 1.67 m/s before BR (pre-BR), after BR (post-BR) and after PT (post-PT).
Results
No effects of BR and PT were observed on the parameters analyzed in both groups . Elderly subjects showed higher CW (at each speed, by mean 25.6%, $P<0.001$), co-contraction time of proximal muscles (at speeds of 0.83, 1.11 and 1.67 m/s by 52.3, 25.2% and 24.2% respectively, $P<0.05$) as well as co-contraction time of distal ones (at each speeds by 157.7, 165.7, 89.1% and 28.5% respectively, $P<0.05$) than Y subjects. The E group had lower EFF (among all speeds by mean of -18.5%, $P<0.05$) than the Y group.
Discussion
The absence of changes in CW, mechanical work and co-contration values observed post-BR and post-PT could be related to the healthy status of the participants especially the E ones (Kortebein et al. 2008, Coker et al. 2015) or the relative short duration of the BR. Even if the E performed the same mechanical work as the Y subjects during walking, the former showed higher CW than the latter. This may be explained, at least partially, by the higher co-contraction time of lower limb muscles seen in E than in Y (Grabiner et al. 2001).
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Contact
flore.mirco@hotmail.it

IMPACT OF STRENGTH AND ENDURANCE VARIABLES ON THE PHYSIOLOGICAL DEMANDS OF FIREFIGHTING IN DIFFERENT ENVIRONMENTS

WINDISCH, S.1, HAHN, D.2,3, SEIBERL, W.1, SCHWIRTZ, A.1

1 TECHNISCHE UNIVERSITÄT MÜNCHEN (GERMANY), 2 RUHR-UNIVERSITÄT BOCHUM (GERMANY), 3 UNIVERSITY OF QUEENSLAND

Introduction
Fitness is an important prerequisite to perform firefighting tasks safely and healthy. The purpose of this study was to determine the different physiological demands during simulated firefighting with and without heat. Therefore, we investigated the impact of various strength and endurance variables related to firefighting performance.
Methods
Sixteen professional firefighters performed two simulated firefighting tasks. A standard firefighting task (SFE) was conducted in temperate conditions (20°-30°) while a flashover training (FOT) was conducted in extreme heat (300°). Firefighting performance during the simulated

exercises was evaluated by a simple time-strain-air depletion model (TSA) (Windisch et al. 2017) taking the sum of z-transformed time to finish the exercise, mean heart rate, and air depletion from the breathing apparatus. Furthermore, subjects performed strength tests and a maximum treadmill testing to determine maximum heart rate (HR), peak oxygen uptake (VO2peak), ventilatory threshold (VT1), and respiratory compensation point (RCP). Three physiological intensity zones were identified according to the HR values corresponding to VT1 and RCP. Pearson correlations established the relationship between the TSA-model, physiological and strength parameters.
Results
No significant difference (p=.964) was found between TSA-scores of SFE (0.07±2.01) and FOT (0.04±1.5). Mean SFE completion time was significantly (p=.003) shorter (13.2±1.8 min) compared to FOT completion time (15.5±1.2 min). Air depletion from the SCBA was significantly higher (p=.002) during SFE with 162.2±24.4 bar compared to FOT with 140.0±23.7 bar. Mean HR was lower (p=.001) during SFE (79.4±0.1 % HRmax) than during FOT (85.4±5.2 % HRmax). During SFE subjects spent 25.0±30.2 % of time in zone 1, 65.4±26.8 % in zone 2 and 9.6±16.7 % in zone 3. During FOT subjects spent 16.3±12.9 % in zone 1, 50.4±13.2 % in zone 2 and 33.3±16.6 % in zone 3. Relative VO2peak showed a strong correlation to mean HR during SFE (r = -.574) and was highly correlated to mean HR in FOT (r = -.722).
Discussion
We found relative VO2peak to be the primary physical variable related to the different aspects of firefighting. The capability to provide energy aerobically (time spent in zone 1) is an important prerequisite for firefighting exercises. Extreme temperatures and flashovers during a firefighting exercise additionally increase the physiological demands and especially the proportion of the anaerobe metabolism raises in order to provide the energy needed for solving the task.
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Contact
stephanie.windisch@tum.de

INFLUENCE OF ENERGY RESTRICTION AND MODERATE INTENSITY EXERSISE TRAINING ON SERUM BETA-AMINOISOBUTYRIC ACID

ISHIHARA, M.1, TOBINA, T.1,2, SHIOSE, K.2,3, YOSHIMURA, E.2,4, KUMAHARA, H.2,5, AYABE, M.2,6, MATSUDA, T.2, KIYO-NAGA, A.2, HIGAKI, Y.2, TANAKA, H.2

1: UNIV OF NAGASAKI (JAPAN), 2: FUKUOKA UNIV (JAPAN), 3: JAPAN INSTITUTE OF SPORTS SCIENCE (JAPAN), 4: PREF UNIV OF KUMAMOTO (JAPAN), 5: NAKAMURA GAKUEN UNIV (JAPAN), 6: OKAYAMA PREF UNIV (JAPAN)

Introduction
Beta-aminoisobutyric acid (BAIBA), a product of valine degradation, is a known myokine. Serum BAIBA is regulated by muscle PGC-1 alpha, and activates beta-oxidation in hepatocytes (Roberts LD et al., 2014). Previous studies demonstrated that energy restriction and moderate intensity exercise training reduce liver fat. Thus, energy restriction or exercise training may reduce liver fat via effects on BAIBA. This study aimed to investigate whether energy restriction or moderate intensity exercise training increase serum BAIBA.
Methods
Thirty-three participants were randomly assigned to one of three groups: dietary energy restriction (ER; n=9), exercise training (Ex; n=12) or control (Con; n=12). Over the 12-week intervention period, participants in the ER group ate an energy-restricted diet: calorie intake was calculated as the participant's ideal body mass (kg; based on BMI=22) x 25 kcal/day. Participants in the Ex group exercised at lactate threshold intensity for 300 min/week. Blood samples were obtained from the antecubital vein after overnight fasting. Serum BAIBA was measured using liquid chromatography tandem-mass spectrometry (LC–MS/MS) and hydrophilic interaction liquid chromatography (HILIC). To assess liver fat, liver-to-spleen ratio was measured using computed tomography.
Results
After the 12-week intervention, body mass and BMI were significantly reduced in the ER and Ex groups. Liver fat was reduced in only the ER group (1.03±0.39 and 1.12±0.38, p=0.04; before and after intervention). However, serum BAIBA did not change in any of the groups (ER: 0.19±0.09 μM, 0.18±0.10 μM; Ex: 0.21±0.11 μM, 0.22±0.11 μM; Con: 0.24±0.12 μM, 0.22±0.14 μM; baseline and after intervention, respectively). There was no correlation between the changes in liver fat and serum BAIBA in the ER group.
Discussion
Moderate intensity exercise and energy restriction increase muscle PGC-1 alpha. They may also increase serum BAIBA concentration; however, this study found no significant changes after a 12-week intervention. Liver fat reduction due to energy restriction may be independent of serum BAIBA concentration.
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Contact
M321001@sun.ac.jp

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CP-PM09 Biochemistry and nutrition

PLASMA IL-6 AND LIPIDS IN MALE100-KM ULTRAMARATHONERS

CHIU, Y.H., LAI, J.I., KAO, W.F., CHANG, W.H.

MACKAY MEMORIAL HOSPITAL

Introduction
The factors responsible for the acute effects of exercise on changes in lipids are not well known. Interleukin-6 (IL-6) has been reported to enhance lipid turnover by stimulating lipolysis and fat oxidation. IL-6 might be an important mediator of the lipid metabolism in Asian

male ultramarathoners after a 100-km (62.5-mile) ultramarathon event. Objective: To investigate the association between plasma IL-6 and lipids in male ultra-marathoners after a 100-km ultra-marathon event.
Methods
25 runners were prospectively recruited into our study. Plasma IL-6 and lipid profiles were analyzed 1 week before, immediately following and 24 hours after the the 2011 Flexpower Cup National 100-Km Ultra-Marathon, in Taipei, Taiwan.
Results
Blood concentrations of IL-6 and ketone of the recruited runners showed significant increases both immediately after and 24 hours post-race compared with pre-race values. The serum total cholesterol values revealed a statistically significant rise in the immediate post-race values and a rapid drop in values at 24 hours post-race. There was an increase of high density lipoprotein cholesterol (HDL_C), as well as a decrease of low density lipoprotein cholesterol levels in 24 hours post-race blood tests. Triglyceride (TG) and TG/HDL_C ratio increased immediately post-race. The fractional change (i.e., post-race value – pre-race value / pre-race value) in IL-6 had no correlation with the fractional changes in lipids.
Discussion
Running a 100-km ultra-marathon will induce substantial changes in lipids. No link between the plasma IL-6 and lipids found in our data represented this proposition.

EFFECTS OF EXERCISE TRAINING ON ANTIOXIDANT ACTIVITY AND GENE EXPRESSION IN RAT HIPPOCAMPUS

FUSI, J., FEDERIGHI, G., DANIELE, S., CERRI, E., BANDUCCI, R., PETROCCHI, A., GALETTA, F., SCURI, R., MARTINI, C., FRANZONI, F.

UNIVERSITY OF PISA

Introduction
Regular exercise promotes brain function via a wide range of adaptive responses, including the increased expression of antioxidant systems. In the present study, we investigated the effects of exercise training on brain antioxidant capability and the expression of nerve growth factor (NGF) and silent information regulators (SIRT1 and SIRT3).
Methods
Sixteen 30-day old male Wistar rats were divided into a sedentary group and a treadmill exercised group. The exercised group run on a treadmill for 30min per session at a speed of 8m/min and 0° slope, five times a week for 6 weeks. The animals were sacrificed one week after the exercised period, brains were dissected, and homogenate of the hippocampal dentate gyrus was obtained from each rat. The scavenging properties for peroxyl, hydroxyl and peroxynitrite radicals were quantified by the TOSC assay. The expression of NGF and SIRT1 and 3 was assessed by real-time quantitative polymerase chain reaction (qRT-PCR).
Results
Exercised rats showed higher antioxidant activity against peroxyl radical (13.72±2.70 vs 9.10±0.91 TOSC Units, $p<0.01$), hydroxyl radicals (16.90±2.05 vs 13,49±1.66 TOSC Units, $p<0.01$) and peroxinitrite derivates (15.94±1.96 vs 10.96±2.67 TOSC Units, $p<0.01$) than control group. In addition, exercise training significantly increased the expression of NGF ($p<0.01$), SIRT1 ($p<0.05$) and SIRT3 ($p<0.05$).
Discussion
These results indicate that regular aerobic exercise was able to increase antioxidant capability and NGF and SIRT1-3 activation in the rat hippocampus, thus demonstrating a role of physical activity in preventing age-induced cognitive decline and neurodegeneration.

THE DIFFERENCE OF THE ORDER OF CONCURRENT TRAINING ON MUSCLE HYPERTROPHY AND METABOLISM

SHIRAI, T., TOHRU, T.

UNIVERSITY OF TSUKUBA

Introduction
In many sports, athletes have to show maximum performance during competitions. Therefore, they want to improve strength and endurance by many ways. Much has been studied on the differences in training methods weather those can improve endurance, strength on both of them. Concurrent training is combination containing two different modes of training. In this study, I conducted an experiment by combining resistance and endurance training. Therefore, there is a conflict of body adaptation caused by differences in the respective training. The purpose of this study was to investigate the order of concurrent training in skeletal muscle and its influence on its molecular mechanism. I analyzed the change in signal molecules.
Methods
7 weeks of age male ICR mice were divided into 3 groups: control (con), endurance before resistance (EE-RE), endurance after resistance (RE-EE). After 3-week training, mice were sacrificed and plantaris muscles were dissected out quickly from each mouse for subsequent analyses. The mice were familiarized with running on a rodent treadmill at 10–20 m/min for 3 days prior to the experiment. Subsequently, they were placed on a flat treadmill and made to run for 30 min at a speed of 20m/min. The mice were positioned with their foot on a footplate (the ankle joint angle was positioned at 90°) in the prone posture. The triceps calf muscle was stimulated percutaneously with electrodes which were connected to an electric stimulator and isolator. The gastrocnemius muscle was isometrically exercised (3-s stimulation 10 contractions, with a 7-s interval between contractions, for 5 sets with 3-min inter set intervals). The voltage (30 V) and stimulation frequency (100 Hz) were adjusted to produce maximal isometric tension.
Results
I analyzed the change in signal molecules. The phosphorylation levels of p70S6K, S6, 4E-BP1 increased significantly in resistance-first group. The change in gene expression related to metabolism were not confirmed due to the order of concurrent training. Mitochondrial respiratory chain complex was confirmed by western blot. Although it increased significantly in complex 4, we could not confirm the difference by the order.
Discussion
We revealed the difference by order of concurrent training. In conducting concurrent training on the same day, resistance training before endurance training is effective for both strength and endurance enhancement.
Contact
takemasa.tohru.gm@u.tsukuba.ac.jp

DIURNAL VARIATION OF THE POSTEXERCISE URINE LACTATE CONCENTRATION

MOUGIOS, V., NIKOLAIDIS, S., KOSMIDIS, I., SOUGIOULTZIS, M.
ARISTOTLE UNIVERSITY OF THESSALONIKI

Introduction
The postexercise urine lactate concentration is a potential novel biomarker of anaerobic carbohydrate catabolism (Pechlivanis et al., 2010). Its reliability was good when assessed after exercise tests performed in the morning (Nikolaidis et al., 2016a; Nikolaidis et al., 2016b). The aims of the present study were to examine the reliability of the postexercise urine lactate concentration in the afternoon and the possible existence of diurnal variation.
Methods
Thirteen healthy male and eight healthy female active swimmers performed three identical tests of eight 25 m bouts of maximal freestyle swimming on 2 min with passive recovery in between, spaced three days apart. Two of the tests were performed in the afternoon and one in the morning. Postexercise blood and urine lactate, as well as urine creatinine, were measured spectophotometrically. The intra-class correlation coefficient (ICC) was used as a reliability index of the afternoon test and retest, as well as between the morning and afternoon tests. A correlation analysis between the blood and urine lactate concentrations was also performed.
Results
The reliability of swimming performance at the three tests was excellent (ICC > 0.9). The reliability of the blood lactate concentration was high between the afternoon test and retest (ICC = 0.89) but lower between the morning and afternoon tests (ICC = 0.73). The urine lactate concentration exhibited high reliability between the afternoon test and retest (ICC = 0.81) but low reliability between the morning and afternoon tests (ICC < 0.5). However, this was greatly improved after normalizing to the creatinine concentration (ICC > 0.8 in all cases). The urine and blood lactate concentrations were moderately correlated in the morning (r = 0.46) and highly correlated in the afternoon (r > 0.80).
Discussion
The reliability of the postexercise urine lactate concentration is high when tests are performed at the same time of the day. The low reliability when tests are performed at different times of the day suggests the presence of diurnal variation. However, this variation can be eliminated by normalizing to creatinine concentration. Thus, urine lactate could be measured reliably in exercise tests preformed either in the morning or in the afternoon. The moderate-to-high correlation between the blood and urine lactate concentrations strengthens the evidence gathered in our previous works for urine lactate being a valid exercise biomarker (Nikolaidis et al., 2016a; Nikolaidis et al., 2016b). Future studies should investigate the applicability of this novel biomarker.
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URINE SPECIFIC GRAVITY, WATER INTAKE AND SUBJECTIVE FEELINGS OF ADOLESCENT STUDENT-ATHLETES OVER THREE CONSECUTIVE DAYS

APHAMIS, G., KILE, S., CONSTANTINOU, R., ANDREOU, E., GIANNAKI, C.D.
UNIVERSITY OF NICOSIA

Introduction
Adolescent student-athletes must perform well both at school and in sport. Young soccer players have been shown to be hypohydrated (Philips et al, 2014) and inadequate water intake during school hours can hinder concentration and cognition (Edmonds et al., 2017). The aim of the present study was to assess hydration level of adolescent student-athletes during school time, water intake and related subjective feelings for three consecutive school days.
Methods
46 male adolescent student-athletes (age 13.3 ± 1.0 y) participated in this study. Urine specific gravity (USG) was assessed on arrival at school (~7.30am) and at the end of the school day (1.30pm), for three consecutive days. At the same time points, the participants completed a subjective feelings questionnaire on thirst, fatigue, concentration and alertness (10-cm visual analog scale, Shirrefs et al., 2004). Detailed food and fluid intake records were kept during the study. Participants were classified as euhydrated (USG < 0.120), dehydrated (USG 1.020-1.029) and seriously dehydrated (USG > 1.030). Comparisons between hydration groups were performed using Repeated Measures ANOVA. Correlations between USG and subjective feelings were performed using Pearson's Correlation.
Results
There was no change in USG between beginning and end-of-school-day, nor from day-to-day. 27.2% of the participants appeared euhydrated, 51% dehydrated, and 21.8% seriously dehydrated. Water intake during school hours was 300 - 444 ml for eyhydrated participants, 252 - 321 ml for dehydrated participants and 166 - 393 ml for seriously dehydrated participants. Thirst was similar between groups, both in the morning (p = 0.292) and at the end of the school day (p = 0.787). USG correlated with increased fatigue and decreased feeling of alertness and concentration (p < 0.050).
Discussion
A large proportion of adolescent student-athletes arrives at school dehydrated and remains so for consecutive days. Water intake from fluids and solid food is inadequate to restore euhydration, as thirst alone does not drive adolescents to drink enough. The increased feeling of fatigue and the decreased feelings of concentration and alertness may well hinder performance at school and competitive sport alike. Proper education may be required to raise awareness on the importance of hydration and fluid intake.
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THE EFFECTS OF MONTMORENCY TART CHERRY JUICE SUPPLEMENTATION ON FAT OXIDATION DURING FATMAX EXERCISE AND CARDIO-METABOLIC MARKERS AT REST

DESAI, T., BOTTOMS, L., ROBERTS, M.G.

UNIVERSITY OF HERTFORDSHIRE

Introduction

Montmorency tart cherries (Prunus cerasus) are rich in anthocyanins (Kirakosyan et al., 2009), compounds capable of augmenting fat oxidation and regulating metabolic dysfunction (He and Giusti, 2010). Aerobic exercise at individual FATMAX (conveyed as percentage of maximal oxygen uptake (%VO2max)) has been shown to alleviate symptoms associated with Metabolic Syndrome (MetS), partly through enhancing fat oxidation rates (Brun, Romain and Mercier, 2011). As this was the first study to incorporate exercise and Montmorency tart cherry juice (MTCJ) supplementation in tandem, healthy participants were recruited to observe cardio-metabolic responses and assess for any adverse effects. The present study examined whether MTCJ supplementation could augment fat oxidation rates during FATMAX exercise and mitigate symptoms of MetS in healthy participants.

Methods

Eleven healthy, recreationally active, participants (18-45 years) consumed MTCJ (30mL concentrate with 100mL water) or placebo (PLA) twice daily, in a random, counterbalanced order for 20 days. Participants cycled at their individual FATMAX (determined using an incremental protocol adapted from Achten, Gleeson and Jeukendrup, (2002)) for 1 hour pre-, mid- (10 days) and post-supplementation during which substrate oxidation rates were measured. Waist circumference, body composition and resting metabolic rate were measured pre-post exercise. Blood pressure, serum triglycerides, cholesterol, HDL, total antioxidant status (TAS), glucose and lactate were measured immediately before and after the 1 hour exercise. LDL was later calculated using the formula by Ahmadi et al. (2008).

Results

No significant differences ($p>0.05$) between conditions or interactions were observed for any blood-based biomarkers, blood pressure, waist circumference, body composition or fat and carbohydrate oxidation rates during exercise or rest. Pre-exercise TAS ($p=0.036$) and HDL ($p=0.001$) values were significantly reduced from mid- to post-supplementation with MTCJ but not PLA.

Discussion

Supplementation of MTCJ for 20 days did not augment fat oxidation rates at rest or during FATMAX exercise in healthy, recreationally active individuals. These results were likely confounded by the high carbohydrate content of MTCJ. Beyond 10 days' supplementation, MTCJ could not maintain elevated TAS and HDL levels. In line with previous research (Lynn et al., 2013), blood-based and functional cardio-metabolic markers associated with MetS were not significantly improved, likely due to the healthy baseline values and high inter-individual variability presented by the participants. Therefore, it is unnecessary to supplement MTCJ in this participant cohort to improve MetS symptoms.

LOW-DOSE OF CAFFEINE IMPROVES INTERMITTENT CYCLING PERFORMANCE IN HOT AND HUMID ENVIRONMENTS

NAKAMURA, D.

JAPAN INSTITUTE OF SPORTS SCIENCES

Introduction

Many major international competitions are held in hot environment. The recent summer Olympic games are no exception, and these took place under high ambient temperatures. This trend is likely to continue as athletes begin to prepare for what will likely be Olympics and Paralympics in Tokyo 2020. Although caffeine is widely known as a substance that enhances exercise performance in thermoneutral condition, there is little evidence of its effect on exercise performance in hot and humid environment. Thus, the purpose of this study was to determine the effects of low dose of caffeine on team sports simulated intermittent exercise and cognitive function in hot and humid environments.

Methods

Eight well trained male soccer players participated in this double-blind, controlled, randomized cross-over study. Sixty minutes prior to main exercise, caffeine was orally administrated at a dosage of 3 mg•kg-1, whereas same dose of lactose was administrated for the control condition. Thirty minutes before starting the main exercise, subjects moved to the climate chamber (Ta 32 °C, Rh 70 %). The main exercise consisted of two halves that were separated by a half-time rest period of 15 minutes. Each half was divided into 3 sets of seven cycling intermittent sprint protocol (CISP). At the end of each set, cognitive function was assessed by using 8 × 8 grids test. Rectal temperature was measured throughout the exercise.

Results

A significant main effects of condition ($p < 0.05$) was found in total mean power output. Rectal temperature of half time in caffeine condition was significantly higher ($p < 0.05$) than that of control condition. The total scores of grid test of 2nd half tended to be greater in the caffeine condition compared to that of the control condition but not significantly different.

Discussion

Our study found that total power output was significantly greater in caffeine condition in hot and humid environments. From the data of our study, it appears that low dose of caffeine has an ergogenic effect on intermittent performance without significant increase in core temperature. Consequently, the results of the present study provide useful information for not only athletes but also coaches who want to maximize their performance in hot and humid environments.

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Contact

daisuke.nakamura@jpnsport.go.jp

EFFECTS OF PROTEIN INTAKE DURING A 10-DAYS MILITARY EXERCISE WITH ENERGY DEFICIT ON MUSCULAR PERFORMANCE

ØFSTENG, S.1, RØNNESTAD, B.R.1, JØSOK, Ø.3, HELKALA, K.3, ELLEFSEN, S.1,4, GARTHE, I.2

INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES

Introduction

Prolonged periods of energy deficit combined with exercise can result in decreased body mass and physical performance [1]. This can be counteracted by ingestion of protein, creating a positive protein balance and altering protein metabolism [2, 3]. The present study investigated the effects of moderate vs high protein intake on muscle mass and function during a 10-days intense military exercise in a state of energy deficit followed by 7 days of recovery.
Methods
Thirty eight soldiers (21.0±0.8 years, 76.0±12.1 kg, 182±9 cm) were randomly assigned to moderate (1 g.kg-1.d-1; MOD) or high protein intake (2 g.kg-1.d-1; HIGH) during the 10-days of military exercise. There was no differences in daily energy intake between MOD and HIGH before the military exercise (45.6±16.1 kcal.kg-1.d-1 and 49.7±16.2 kcal.kg-1.d-1, respectively, p=0.5). Daily energy intake was reduced to 15 kcal.kg-1.d-1 for both groups during the exercise. The effects of MOD vs HIGH were measured in counter movement jump (CMJ), 1 repetition maximum (RM) bench press, mean power during a 30-s Wingate sprint and body mass. Tests were performed immediately before and after the 10-day military exercise and then after 7 days of recovery.
Results
From pre to post military exercise, MOD and HIGH exhibited decreased performance in CMJ (MOD:-14.9±6.8% and HIGH:-14.5±8.8%), 1RM bench press (MOD:-9.4±3.8% and HIGH:-9.6±5.4%), mean power Wingate sprint (MOD:-16.4±5.4% and HIGH:-18.7±6.3%) and body mass (MOD:-5.6±1.2% and HIGH:-5.6±1.4%). From post military exercise to 7 days of recovery, both groups regressed towards pre-exercise values in 1RM bench press, Wingate sprint and body mass, with no improvement being seen for CMJ. Changes did not differ between groups at any time point.
Discussion
The main finding was that 10 days of military exercise decreased physical performance in soldiers, with no beneficial effect of increasing protein ingestion. This is in line with a previous study performed with a similar time frame [1]. However, it contradicts studies performed with a longer time span, where nutritional supplements led to maintenance of physical performance despite energy deficit [3, 4]. In conclusion, increased protein intake did not prevent a reduction in muscular strength and power during a 10-day military exercise performed in a state of energy deficit.
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Contact
sjur.johansen.ofsteng@inn.no

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CP-PM11 Muscle physiology and repair

INFLUENCE OF RESISTANCE TRAINING INTENSITY ON MUSCLE SWELLING IN HEALTHY YOUNG MEN

HIRONO, T., IKEZOE, T., ARATA, D., ICHIHASHI, N.
KYOTO UNIVERSITY

Introduction
Muscle swelling immediately after resistance training (RT) is known to be an important factor in promoting muscle hypertrophy. Muscle swelling has been previously defined as the increase in muscle thickness (MT) determined from ultrasound images immediately after training (Fahs, 2015). However, no study has investigated the degree and duration of muscle swelling following RT. We therefore examined the time course of changes in MT resulting from different training intensities and investigated the acute effects of different training intensities on muscle swelling in healthy young men. We hypothesized that high-intensity RT causes a greater degree and longer period of muscle swelling in comparison with low-intensity RT.
Methods
Eleven healthy young men performed knee extension RT consisting of 3 sets of 8 repetitions, using a dynamometer (BIODEX). RT was performed randomly at 3 different intensities (30%, 50%, and 80% of one-repetition maximum intensity [1RM]) with 72 hours of rest between trials. The increase in MT, as measured by B-mode ultrasound, was used as the indicator of muscle swelling. MT of the rectus femoris was measured prior to RT, immediately after RT (POST), and at time points of 5 min, 10 min, 20 min, and 30 min after RT. A two-way repeated measures ANOVA with factors of intensity and time was performed to analyze interaction effects. When the ANOVA indicated a significant interaction and a significant main effect, further comparisons were performed using Bonferroni-corrected t-tests.
Results
The ANOVA revealed significant interaction and main effects for both intensity and time. The post hoc analysis of time effects indicated that a significant increase in MT was present from POST to 20 min after RT in the 80% intensity group. In contrast, a significant increase in MT was observed only from POST to 10 min after RT in the 50% intensity group, and only at POST in the 30% intensity group. In addition, MT in the 80% intensity group was significantly greater than MT in the 30% intensity group at time points from POST to 30 min after RT.
Discussion
It has been reported that stimulation needed for muscle hypertrophy is dependent on the degree of training intensity, and that the increases in MT immediately after exercise are caused by damage to the skeletal muscle (Schoenfeld, 2013). Skeletal muscle damage may be necessary to induce muscle hypertrophy. We found that there was a greater degree and longer duration of muscle swelling following high-intensity RT (80% of 1RM) in comparison to low-intensity RT (30% of 1RM). These results suggest that evaluation of the degree and duration of muscle swelling may provide an indication of stimuli associated with muscle hypertrophy.
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DOES WHOLE BODY CRYOTHERAPY IMPROVE MUSCLE RECOVERY AFTER DAMAGING ECCENTRIC EXERCISE

ROSE, C., LEDGER, S., GRAHAM, K., SEIGLER, J., EDWARDS, K.E., CAILLAUD, C.

SYDNEY UNIVERSITY

Introduction
Inflammation and pain caused by exercise are involved in reducing peak muscle force generating capacity. Previous studies suggest that exposure to cold temperatures, including very cold treatment such as whole body cryotherapy (WBC), can modulate inflammation and pain, thereby shortening recovery times. The aim of this study was to compare the effect of WBC with cold-water immersion (CWI) on muscle performance after damage. We hypothesise that WBC will attenuate the inflammatory response and promote a faster recovery than CWI or control.
Methods
Twenty-four healthy, strength trained men (23.7±5yrs) were randomised into one of three treatment groups: CWI at 9°C, WBC at -140°C or a room temperature control at 24°C. On the first visit, participants underwent initial measure of their muscle voluntary contraction (MVC) as well as a 3-minute exposure to their allocated treatment. Seven days later an eccentric damage protocol was conducted on the left leg with exposure to the recovery treatment immediately post. Blood samples, saliva samples, pain scores and MVC testing were done before, within 30 min of completion and then 24h, 48h, and 96h following the damaging exercise. Blood samples were analysed for IL-6 and IL-10 while cortisol was sampled in saliva. Combined, these provide markers of systemic inflammation processes in recovery over time.
Results
No statistically significant interaction was found between treatment and time for any variable. There was a significant increase over time for IL-6 in all treatment groups $F(5, 70) = 4.62$, $p<0.05$; although no significant difference between treatments was found. There was no significant effect on IL-10 over time or between groups, as with no significant time or group effect for cortisol. Improvement in muscle function was not facilitated by recovery techniques over the 7-day recovery period, despite all tests having a substantial effect for time. There were no significant changes in seated pain measures across all time points ($F(2, 17) = 0.353$), nor between groups over time ($F(4, 38) = 0.697$).
Discussion
Neither CWI nor WBC had a significant impact on the acute recovery of the inflammatory response or muscle recovery from eccentric muscle damage. IL-6 and IL-10 increased after the damaging exercise, indicating that our model of exercise lead to the release of these cytokines into the systemic circulation. This response was not altered by either cold treatment though, suggesting that a unique exposure to 3min of WBC had limited influence to inflammatory pathways and provided no improvement to athletic recovery.

EFFECTS OF RECOVERY WITH COMPRESSION GARMENTS ON POWER PERFORMANCE AND PERCEIVED MUSCLE SORENESS AFTER A STRENGTH TRAINING WORKOUT

ARLEGUI, L., HÄGGBLOM, J., HAGLUND, E., BOON, H.

HALMSTAD UNIVERSITY

Introduction
Compression garments are elastic pieces of clothing with a pressure gradient. Compression garments have become a popular method to recover from exercise among recreational athletes, but their efficacy is debated. Compression garments may promote a reduction of muscle soreness hence the aim was to investigate whether recreational athletes wearing full leg customised compression garments for 15 hours following a strength training workout changed performance outcomes and muscle soreness scores.
Methods
Twelve subjects (2 males, 10 females) took part in a cross-over, randomised, controlled study. Subjects performed a Wingate anaerobic sprint test, an agility t-test and a broad jump test before completing a strength training workout. Prior to the strength training, subjects were also asked to rate perceived muscle soreness (scale 0-10) in quadriceps, hamstrings and calves. Recovery was with compression garments (CGS) or without compression garments (CON). After 24 hours the performance tests were repeated, including an additional 3 days of muscle soreness assessments. Ten days later the same procedure was conducted however the other recovery method was used. Pattern differences between the two test periods were analysed using two-way repeated measures ANOVA in SPSS version 20.0 (IBM Business Analytics, USA).
Results
There was a significant increase in muscle soreness in quadriceps, hamstrings and calves after the strength training in both test conditions (CON: quadriceps $p= 0.001$, hamstrings $p= 0.005$, calves $p<0.001$ & CGS: quadriceps $p= 0.006$, hamstrings $p= 0.019$, calves $p= 0.016$). These soreness patterns were not different after recovery with compression garments. Wingate sprint (CON: pre- 693±149W, post- 683±156W & CGS: pre- 706±152W, post- 686±166W), agility t-test (CON: pre- 11.8±1.1s, post- 11.8±1.1s & CGS: pre- 11.8±1.1s, post- 11.9±1.2s) and broad jump (CON: pre- 165±32cm, post- 167±30cm & CGS: pre- 173±30cm, post- 172±27cm) performance had not changed 15 hours after the strength training, hence no effects of compression garments were found on any of the performance tests.
Discussion
Moderate-intensity strength training effectively induced muscle soreness after both strength training sessions. However, compression garments did not aid to significantly reduce the severity of soreness compared to the passive recovery intervention. Despite of muscle soreness, no changes were found in any of the performance tests. A dissociation between anaerobic performance and perceived muscle soreness was therefore observed. Future research should look into the effects of compression garments on (muscular) endurance performance such as lactate threshold.
Contact
leigharlegui@gmail.com

THE EFFECT OF REPEATED BOUTS ON SARCOLEMMAL PERMEABILITY AND MUSCLE FORCE PRODUCTION AFTER ECCENTRIC CONTRACTIONS IN RAT SKELETAL MUSCLE

HAYAO, K.1, TAMAKI, H.1, NAKAGAWA, K.1, YOTANI, K.2, OGITA, F.2, TAMAKOSHI, K.1, TAKAHASHI, H.1, ONISHI, H.1, YAMAMOTO, N.3, KASUGA, N.4

1: NIIGATA UNIVERSITY OF HEALTH AND WELFARE (JAPAN), 2: NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA (JAPAN), 3: NIIGATA REHABILITATION HOSPITAL (JAPAN), 4: AICHI UNIVERSITY OF EDUCATION (JAPAN)

Introduction
Eccentric exercise (ECC) frequently induces muscle damage including delayed onset muscle soreness and prolonged loss of muscle strength in animal and human (Nakagawa 2016, Law 2015). However, repeated bouts of the same eccentric exercise performed within several weeks or months results in less severe changes in muscle morphology and biochemical indicators of myofiber damage than the first bout, known as the 'repeated bout effect.' The aim of this study was to evaluate the effect of repeated bouts of eccentric exercise on sarcolemmal permeability and muscle force production in rats.
Methods
Thirty-two male F344 rats (12-16 weeks of age) were divided into four groups: (1) Control, (2) post-ECC1, (3) pre-ECC2, and (4) post-ECC2. For the ECC groups, the left tibialis anterior (TA) muscle was subjected to one or two eccentric exercise bouts (ECC1 and ECC2, respectively) consisting of 80 forced eccentric contractions (200 deg/sec) induced by direct muscle electrical stimulation (ES), separated by four weeks (post-ECC2). Evans blue dye (EBD): a marker of myofiber damage that is associated with increased sarcolemmal permeability, was injected intraperitoneally one day before muscle sampling. Maximum tetanic force (Fmax) evoked by direct ES was measured immediately before muscle sampling. The TA muscle was excised two days after the last ECC session. We performed immunohistochemical staining against dystrophin and laminin on frozen transverse sections of the TA, as well as HE staining for histopathological observations.
Results
A complete absence of dystrophin staining was apparent in all EBD positive fibers analyzed. The number of EBD positive fibers was significantly fewer ($P < 0.05$) in the post-ECC2 group than in the post-ECC1 group. No EBD positive fiber was observed in the Control group. The Fmax was greater ($P < 0.05$) in the post-ECC2 group than in the post-ECC1 group, whereas no significant difference was observed between the Control and pre-ECC2 groups. The Fmax was inversely correlated with the number of EBD positive fibers in the post-ECC1 and post-ECC2 groups.
Discussion
These findings suggest that a single bout of eccentric exercise may remodel the extracellular matrix and/or connective tissue to make the muscle more resilient to the eccentric contraction-induced muscle damage associated with muscle force production. This protective adaptation to eccentric exercise lasts for at least four weeks.
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Contact
hpm16009@nuhw.ac.jp (Hayao K)

HINDLIMB SUSPENSION DEPRESSES MUSCLE SATELLITE CELLS FUNCTION.

OTA, Y., FUJIMAKI, S., TAKEMASA, T.

UNIVERSITY OF TSUKUBA

Introduction
To keep the quantity of skeletal muscle is important to be healthy. Muscle stem cells, termed satellite cells, play the essential role to keep the quantity of skeletal muscle by repairing it. These cells are located between the basal lamina and plasma membrane of skeletal muscle. Satellite cells become active from quiescent, following the stimulation as like muscle damage. After activation satellite cells start to prolifelate and differentiate into mature fibers. It is reported that exercise improve the number and function of satellite cells (Fujimaki et al., 2016). And inactive decrease the number of satellite cells. But the effect of inactive to satellite cells function remain unclear. Here we investigated the effect of hindlim suspension, which is widely used to model inactive, to satellite cells function.
Methods
5 weeks of age male C57/BL6 mice were divided into two groups: control (CON), hindlimb suspension (HS). After 1 week keeping, mice were sacrificed and, gastrocnemius and EDL muscles were dissected out quickly from each mouse for subsequent analyses. EDL muscles were isolated and digested in type I collagenase. Satellite cells were obtained from isolated myofibers. For floating culture, isolated myofibers were cultured in PM (GlutaMaxDMEM supplemented with 10% horse serum, 0.5% chick embryo extract, vand 1% penicillin-streptomycin) at 37°C with 5% CO2, for two days.
Results
After 1 week hindlim suspension, muscle weight decreased in HS group. Immunofluorscene staining revealed that the number of satellite cell also decreased in pre culture, the decline of satellite cells activation in cultured 24 hours and proliferating in cultured 48 hours in HS group. And, Notch signaling, which is thought to regulate satellite cells activation, appeared to have tendency decreasing, but not significant about mRNA expression by real time PCR using gastrocnemius muscle.
Discussion
It is reported that satellite cells function decline in aging (Fujimaki, 2014). In this study suggest that inactivity like hindlim suspension also impair the function of satellite cell to repair skeletal muscle. And, Notch signaling regulate a part of satellite cells function (Fukada , 2007), so this decline might depend on Notch signaling decreasing.
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Contact
takemasa@taiiku.tsukuba.ac.jp

THE EFFECT OF HIGH INTENSITY INTERVAL TRAINING ON HEAT SHOCK PROTEINS EXPRESSION IN TENDON

WANG, D.C., LIU, K.Y.

KAOHSIUNG MEDICAL UNIVERSITY

Introduction
During acute exercise, the type and the magnitude of stress response depend on the short-term modification of cellular homeostasis. Heat shock proteins (HSPs) are expressed under stressful conditions, including the exercise-induced oxidative stress in the contracting muscle or in other tissues, represents one of the most attracting mechanism to maintain the cellular homeostasis (Périard et al., 2015). Because the effect of high-intensity interval training (HIIT) on tendon is not understood, we hypothesized that supplementation of antioxidant before HIIT may modulate the expression of HSPs in Achilles tendon
Methods
Twenty-eight male Sprague-Dawley male rats were randomly divided into the following four groups including control (C, n=8), HIIT (H, n=8), vitamin C (CV, n=8), and HIIT+vitamin C (HV, n=8). The vitamin C (500mg/kg/day) was orally fed for 3 weeks in the CV and HV groups. After one week of vitamin C consumption, animals were subjected to HIIT for 2 weeks. Animals were sacrificed and their Achilles tendons were analyzed for the expressions of HSP27 and HSP70.
Results
The results demonstrate that the expressions of HSP27 and HSP70 were both increased in the Achilles tendons of rats from H group, indicating the HIIT may induce cellular stress. Meanwhile, Vitamin C supplement before and during HIIT decreased the levels of HSP27 and HSP70 in the HV group, indicating the important role of ROS in the HSPs induction during HIIT.
Discussion
The findings of this study suggest that the expression of HSPs in Achilles tendon can be induced by HIIT, which is prevented by vitamin C supplement.
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EFFECT OF LONG-TERM RESISTANCE TRAINING AND PROTEIN SUPPLEMENTATION ON INTRAMYOCELLULAR LIPID CONTENT IN HEALTHY YOUNG SUBJECTS

KATAMOTO, Y., TOTTORI, N., ARIMITSU, T., KURIHARA, T., FUJITA, S.

RITSUMEIKAN UNIVERSITY

Introduction
Accumulation of intramyocellular lipids (IMCL) has been associated with insulin resistance. Oversupply of lipids and inactivity both have been shown to increase IMCL. On the contrary, chronic endurance training leads to improved insulin sensitivity as well as paradoxical increase in IMCL in healthy individuals. As a different mode of exercise, resistance training (RT) has been shown to increase muscle mass and strength, and some studies reported further increase in muscle mass when protein supplementation was given during the training. On the contrary, effect of chronic RT and protein supplementation on IMCL and extramyocellular lipids (EMCL) has not been investigated.
Methods
Twenty four healthy young men (age: 21.6±0.32 years) participated in the study. Subjects were randomly assigned to either RT with protein supplementation (RT+PRO; 30g/day, N=12) or resistance exercise with isoenergetic carbohydrate supplement (RT+CHO; N=12). Subjects in both groups participated in a progressive RT program using upper and lower body exercises using weight machines (3 times/wk, 12 weeks) while ingesting respective supplements every day during the intervention. Before and after the training period, all subjects were tested on body composition (DXA; fat mass, fat-free mass, %body fat), muscular strength, and intra- and extra-myocellular lipids (1H-MRS; IMCL and EMCL at vastus lateralis).
Results
The whole body fat-free mass significantly increased in both groups after the training period ($p<0.05$), but no significant difference was observed between groups. Training-induced decrement in %body fat tended to be greater in RT-PRO as compared with RT-CHO ($p=0.07$). Isometric knee extension strength increased significantly in both groups ($p<0.05$) after training without a significant group difference. EMCL increased significantly only in RT-PRO ($p<0.05$), while no change was observed in RT-CHO. IMCL decreased significantly in both groups after the training period (significant time effect; $p<0.05$).
Discussion and Conclusion
Current study aimed to investigate the effect of chronic RT in combination with protein supplementation on IMCL and EMCL. Regardless of supplementation, 12-wk resistance training resulted in reduced IMCL, which is contrary to a previous study that indicated a significant increase in IMCL after 6-wk RT in healthy men (Zhu et al.). While resistance exercise alone did not affect EMCL, this study to indicate for the first time that protein supplementation during resistance training resulted in a significant increase in EMCL.
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Contact
yu0310ta@gmail.com

EFFECTS OF THE OLYMPIC MATCH SCHEDULE ON FOOTBALL PERFORMANCE, HEART RATE VARIABILITY, AND PHYSICAL CONDITION.

NAKAMURA, M.

JAPAN INSTITUTE OF SPORTS SCIENCES

Introduction
Football players are supposed to play 3 matches in 7 days in the Summer Olympic Games, thus having only 3 days (72 hours) of recovery between the matches. It is essential for the athletes to monitor and evaluate their daily change in physical condition during 3 days recovery. Although non-invasive measurement of heart rate variability (HRV) in athletes physical condition is useful, it has not been proved

enoughly in Olympic schedule. The purpose of this study was to investigate the effects of the Olympic match schedule on football performance, HRV, and subjectively perceived physical condition.
Methods
Eight male collegiate soccer players competed in 3 matches (M1, M2 and M3) in 7 days with a 3 recovery days. As an evaluation of football performance, total distance covered was measured by GPS system. Resting HRV, post-exercise cardiovagal reactivation (T30), and subjective perceived physical condition were measured every morning. R-R interval data in HR measurement during the last 5 min of the supine rest period were examined using power spectral analysis. Power spectra using spectral analysis were defined as two components: 0.04-0.15 Hz (low frequency, LF) and 0.15 - 0.40 Hz (high frequency, HF). Square root mean of the sum of the squares of differences between adjacent R-R intervals (rMSSD) was calculated. The time constant of HR decayed for the first 30 s after exercise (T30), which is an index of vagally mediated HR recovery immediately after exercise. Subjectively perceived fatigue, vigor, and daily training load was estimated on visual analog scales (100mm).
Results
Daily training load increased in the day after the M1, M2, respectively ($p < 0.05$). Vigor was decrease from M1 to M3 ($p < 0.05$). HF was decreased in the morning of the M2 compared with M1 and M3 ($P < 0.05$). Fatigue, rMSSD and T30 were not changed among 3 matches. The total distance covered in the 3 matches did not decrease. However, significant correlation between total distance covered and T30 was observed ($r = -0.47$, $p < 0.05$).
Discussion
Although the physical performance in the 3 matches did not decrease, HRV and subjectively perceived physical condition changed between the 3 matches. In conclusion, our present results suggested that 3 matches in 7 days had an effect on HRV, and subjectively perceived physical condition. Using non-invasive indices, it is important to grasp the 3 days recovery situation and use it for conditioning.
Contact
mariko.nakamura@jpnsport.go.jp

THE EFFECT OF ISOKINETIC RESISTANCE LOAD ON GLYCOLYSIS RATE

NITZSCHE, N., ZSCHÄBITZ, D., BAUMGÄRTEL, L., SCHULZ, H.

TU CHEMNITZ

Introduction
Numerous sports have characteristic short-term or intermittent intensive loads. Intensive muscular loads lead to a high stress on the anaerobic alactacide and lactacide energy metabolism. The knowledge of the maximum glycolysis rates is important for the overall assessment of the energy metabolism during force loading. Various studies investigated the dynamics of the anaerobic energy metabolism during and after running and pedal loads with different load characteristics. However, systematic studies on the determination of the glycolysis rate (dV/dt La) have not been carried out under resistance loads. The aim of the study was the investigation of the effect of stress duration (repetitions) and movement velocity (ω) on the dV/dt La in isokinetic resistance loads.
Methods
47 trained subjects (age 23.8 ± 3.9 years, height 176.8 ± 8.4 cm, body weight 73.3 ± 11.1 kg, BMI 23.3 ± 2.4 kg /m2) completed 510 tests of a single-legged (flexion and extension) movement without pre-load (Contrex MJ Range of Motion 90°). Movement velocities of 60°/s to 240°/s (30°/s intervals) were performed with different repetition numbers (2 to 16, interval 2). Before and immediately after the load, capillary blood (2µl) was taken for the lactate determination (to 9. afterloading minutes). The calculation of the V La was carried out according to the model of Heck & Schulz (2002). The estimation of alactic time (talac) was determined according to Danforth (1965). For the statistical analysis, an ANOVA with repeated measurement was used. Post-hoc effect was tested using the procedure of Homberg.
Results
The two-way ANOVA showed no significant effect of the factor repetition ($p>0.05$). An interaction effect by repetition x ω was found ($p<0.05$). dV/dt La differed significantly in movement velocities lower than 90°/s (0.14±0.07 mmol/(l*s)) and higher than 180°/s (0.39±0.21) ($p<0.05$).The dV/dt La increased with rising movement velocities ($p<0.05$). talac was 3.22±0.6 s and did not differ between ω ($p>0.05$). The tload ranged from 2.7±0.04 s up to 68.9±0.1 s and the dV/dt La ranged from 0.02±0.03 mmol/(l*s) to 1.1±1.2 mmol/(l*s). The dV/dt La is independent of the duration of the load ($p>0.05$).
Discussion
The first experimental data showed a rising glycolysis rate with an increasing movement velocity. The low talak values in 'all out' resistance loads are comparable with the values of Heck & Schulz (2002). Resistance exercise movement velocity above 120°/s led to a strong activation of the glycolysis rate. It can be assumed, that more fast twitch fibers are activated in higher movement velocities. For a valid model development more data is necessary.
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OXIDATIVE METABOLISM DURING A WHEELCHAIR PROPULSION TEST IN PATIENTS WITH SPINAL CORD INJURY: EFFECTS OF LESION LEVEL

BIASUTTI, L.1, BLANCO, R.2, BIZZARINI, E.2, GRASSI, B.1

1 UNIVERSITY OF UDINE, 2 IMFR GERVASUTTA, UDINE

A functional evaluation of oxidative metabolism during exercise was carried out on 15 patients (age 34.9 ±6.5 yr [range 24-46 yr], BMI 23.1 ±5.6 kg/m2) with spinal cord injury (SCI). Patients (9 paraplegic (P), lesion level D4-D10; 6 tetraplegic (T), lesion level C4-C8) were tested 10.6 ±6.7 yr [range 1-23 yr] after the event (n=12 traumatic, n=2 non-traumatic). Two 4-min exercises were performed in the patient's everyday-wheelchair, one at the self-selected speed (SSS) during habitual activity, and the second at the maximal speed sustainable during an "all-out" effort (MS). Wheelchair propulsion was performed on a computer-controlled ergometer, with no resistance set on rollers. Heart rate (HR), pulmonary O2 uptake (VO2) and biceps brachii oxygenation levels (concentration changes in deoxy hemoglobin + myoglobin, Δ[deoxy(Hb+Mb)], taken as an index of fractional O2 extraction; concentration changes in deoxy and oxy Hb+Mb, Δ[tot(Hb+Mb)], taken as an index of muscle vasodilation; near infrared spectroscopy, NIRS) were determined. Muscle recruitment patterns by EMG and biomechanical analyses have been performed. VO2, HR and the speed during MS were inversely and linearly correlated with the lesion level, and were higher in P vs T. VO2 during MS corresponded to 4.9 and to 2.3 metabolic equivalents of task (METs),

respectively, in P and in T. No significant relationship was observed between Δ[deoxy(Hb+Mb)] and Δ[tot(Hb+Mb)] and the lesion level. No differences between P and T were observed for any variable during SSS. In conclusion, a higher level of lesion in people with SCI was found to be associated with a lower performance, likely due to cardiovascular and muscle recruitment limitations.

14:00 - 15:30

Oral presentations

OP-PM43 Hypoxia and blood flow restriction 2

SKELETAL MUSCLE OXIDATIVE METABOLISM FOLLOWING ISCHAEMIC PRECONDITIONING

JEFFRIES, O., WALDRON, M., PATTISON, J., PATTERSON, S.

ST MARY'S UNIVERSITY

Introduction
Ischaemic preconditioning (IPC) (brief episodes of ischaemia followed by reperfusion) is an effective clinical intervention to reduce the risk of myocardial injury (Murry et al., 1986) and has also been shown to acutely improve endurance exercise performance (de Groot et al., 2010). Repeated bouts of IPC lead to improvements in the vasculature and blood pressure, but it is unclear what effect this may have at the metabolic level. Near-infrared spectroscopy (NIRS) has been reported to be able to detect differences in mitochondrial function (Brizendine et al., 2013). Therefore our aim was to investigate skeletal muscle oxidative capacity following a 7-day IPC protocol.
Method
Sixteen male participants were randomly assigned to two groups which undertook a 7–day IPC protocol (5 minutes arterial occlusion at IPC 220 mmHg or Sham 20 mmHg; followed by 5 minutes reperfusion, x4). Testing was conducted 24-h prior to, and 72hrs following, the IPC protocol. A portable NIRS optode (Portamon, Artinis medical systems) was placed on the gastrocnemius medialis and a blood pressure cuff (Hokanson SC12D, Bellevue, WA) placed around the upper thigh in the supine position. To increase muscle oxygen consumption (mVO2) 15 s electrical stimulation (6 Hz, 250 μS, 60 mA) was applied and immediately followed by a series of 15 brief (5-10 s) arterial occlusions (300 mmHg) to measure the rate of recovery back to resting levels. mVO2 was calculated as the slope of change in O2Hb and HHb during the arterial occlusion and data fitted to a monoexponential curve with time constant extrapolated.
Results
End exercise recovery was accelerated following 7-days of IPC (Pre 21.6 ± 3.9 v.s. Post 18.3 ± 3.9 s; n = 8; $P < 0.05$) representing a -15.5% change. There was no reported difference in the sham group. Resting oxygen consumption was also reduced following the IPC protocol (-0.36 ± 0.14 v.s. -0.29 ± 0.13 % s-1; n = 8; $P < 0.05$) with no difference in the sham group. There were no reported changes in resting blood pressure or resting heart rate.
Discussion
Recovery from electrically-stimulated skeletal muscle exercise was enhanced by ~15% after a repeated IPC protocol. In addition, resting metabolic oxygen consumption in the muscle was reduced following repeated IPC. Together, adaptations in mitochondrial function may facilitate an improvement in oxidative capacity following repeated IPC and supports its use as a strategy to enhance exercise performance.
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Contact
owen.jeffries@stmarys.ac.uk

ISCHEMIC PRECONDITIONING IMPROVES EXERCISE PERFORMANCE FOLLOWING EXHAUSTIVE EXERCISE WITHOUT CHANGES IN OXYGEN KINETICS

ANGELL, P.J, LOWRIE, J., MARWOOD, S.

LIVERPOOL HOPE UNIVERSITY

Introduction
Ischemic preconditioning (IPC) has been shown to have a protective effect on organs through the reduction and prevention of ischemic cell death (Murry et al, 1986). Previous data has demonstrated a positive effect of IPC across a range of exercise modalities and distances (Bailey et al., 2012a; Cruz et al, 2015). Recovery from exercise is a key component of sports performance, however the effect of IPC on recovery from exercise is an area that has received limited attention. We hypothesise there will be a significant improvement in recovery of exercise performance following IPC.
Methods
Thirteen recreationally active, male subjects underwent an incremental test to volitional fatigue followed by a constant work rate (CW) test (85% delta), also until volitional fatigue, with time to exhaustion (TTE) recorded, on 3 occasions. Between exercise tests, participants underwent one of three conditions; control, IPC or Sham. IPC and Sham procedures consisted of 4x5minutes of cuff inflation to 220mmHg (IPC) or 20mmHg (Sham) interspersed with 5 minutes of reperfusion. The control condition consisted on 40 minutes of recumbent rest. Near-infrared spectroscopy was placed at the mid-point of the vastus lateralis with blood lactate measured via finger-prick samples, before and immediately after each exercise bout.
Results
There was a significant effect of group on CW TTE (Wilks' Lambda = .53, $F(1, 12)=4.73$ $p<0.05$, $\omega =0.46$). TTE increased by 16% in IPC vs Con and 5% in Sham vs Con. There was no significant difference in IPC vs Sham TTE, however, there was a mean increase of 11% between conditions. There was no significant difference in lactate concentrations between conditions at all time-points or in pulmonary or muscular VO2 kinetics.
Discussion

IPC showed an positive improvement in recovery of exercise capacity as well as an improved lactate clearance following prior exercise. Whilst specific mechanisms have not been highlighted, it can be postulated that there is an up-regulation of anaerobic metabolic pathways. In addition, improved endothelial function may have aided metabolite clearance from the muscle, facilitating recovery following exercise.

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Oral presentations

OP-PM45 Fluid and bicarbonate intake

CHANGES IN BODY COMPOSITION AFTER LIQUID FOOD-WATER INTAKE IN YOUNG HEALTHY MALES

BULUT, S., ATAKAN, M.M., GÜZEL, Y., KOŞAR, Ş.N., TURNAGÖL, H.H.
HACETTEPE UNIVERSITY

Introduction
Dual energy x-ray absorbtiometry (DXA) method is accepted as a gold standart for the body composition measurements and also being widely prefered due to its usability, and delivering extensive-reliable results on body composition analysis (Andreoli et al., 2009). Recently, there is a debate over efffect of food and liquid intake on DXA body composition measurement parameters.Thus, the aim of this study was to investigate the effects of liquid food-water (LF-W) intake on DXA body composition measurement in young men.
Methods
Fourty five young, healthy men were participated in this study from Ankara region in Turkey. Participants were (mean ± SD) 23.5 ± 3.2 years old, height: 178.8 ± 8.1 cm, weighed 75.1 ± 14.7 kg. The participants were fully aware of the study procedures and associated risks before signing an informed consent form. Extent of the study the participants were attended the DXA whole body composition measurement two times with one hour break in fasting (F) and after LF-W intake in the morning. Following F measurement, the participants were provided 500 ml liquid food (Ensure plus, Abbott Nutrition, UK) and 1500 ml water and was told that no urination within this 1 hour period and taken the second DXA measurement. The paired t test and Pearson correlation were used to compare F and LF-W DXA measurements (SPSS 21.0).
Results
LF-W, DXA measurements in comparision to F showed significant increase ($p<0.01$) in fat free mass (F: 61.2 ± 7.7 kg, LF-W: 62.8 ± 7.7 kg), fat mass (F: 16.3 ± 5.7 kg, LF-W: 16.7 ± 5.9 kg), lean body mass (F: 58.1 ± 7.3 kg, LF-W: 59.6 ± 7.3 kg) and total body mass (F: 77.6 ± 11.8 kg, LF-W: 79.6 ± 11.9 kg). But there were no significant differences in bone tissue mass and body fat percentage with F and LF-W, DXA measurements ($p>0.05$). Pearson correlation analyze showed that there were positive powerful relationships between total body mass-fat free mass [r= 0.9], total body mass-fat mass [r=0.84], and total body mass- lean body mass [r=0.9], ($p<0.01$).
Discussion
We've found similar results with Nana et al. (2013) study but a little bit higher body composition component results. We speculated that this would be related to higher liquid food and water intake which was applied in our study. Because in another study, 500 ml liquid and 50 g buttered bread intake had no significant effect over DXA body composition measurement parameters (Vilaca et al., 2009). But higher liquid consumption which was applied in a different study caused significant increase in DXA fat free mass measurement as occured to our study (Horber et al., 1992). In conclusion, LF-W intake significantly increased fat free mass, fat mass, lean body mass DXA body composition parameters, but it was no significant change in body fat percentage. So before the DXA body composition measurement strict food and fluid intake control seems very important.

THE CONSUMPTION OF LIQUID DIET PRE-EXPERIMENTAL TRIALS IMPROVES ADHERENCE COMPARED TO SOLID DIET IN ATHLETES

EL-CHAB, A., CHARLES, S., LIGHTTOWLER, H.
OXFORD BROOKES UNIVERSITY

Introduction
Discrepancies in energy and macronutrient intakes are apparent in research studies even when a solid pre-packaged diet (SOdiet) is used to standardise dietary intake (El-Chab, Simpson, & Lightowler, 2016). It is unknown whether a liquid pre-packaged diet (LIdiet) leads to improved adherence and therefore lower variability in energy and macronutrient intakes. The primary aim of this study was to assess the ability of athletes to replicate a diet when LIdiet and SOdiet were used as dietary standardisation techniques. The secondary aim was to measure the cost and time of preparation of each diet.
Methods
In a crossover design, participants were randomly assigned to either SOdiet or LIdiet, each consumed on two separate days. Participants were instructed to consume all the meals provided and to return the leftovers. They were also asked to record on a food diary sheet any deviation from the diet. The difference in energy and macronutrient intakes between both visits for each condition was then measured. Twenty-eight male athletes completed the study.
Results
The analyses of the scatter plots showed that the observations in SOdiet and LIdiet for energy and macronutrient intakes were distributed around the mean with the exception of some outliers. The CV% of energy and macronutrients for SOdiet were higher than LIdiet (5% and 3% for energy; 5% and 3% for carbohydrate; 5% and 2% for protein; and 5% and 3% for fat, respectively). Energy and macronutrient intakes on day 1 were very strongly, positively correlated ($r > .80$) with those on day 2 for both methods ($p < .05$). The average cost of

SOdiet per participant per trial was £6.60 compared to £4.90 for LIdiet. In addition, the average time spent per visit preparing SOdiet was longer than preparing LIdiet (20 minutes and 8 minutes, respectively).
Discussion
The purpose of the current study was to assess the ability of athletes to replicate a diet when LIdiet and SOdiet were used as dietary standardisation techniques. This study confirms that the liquid pre-packaged diet is an effective technique to standardise diet pre-experimental trials and could be used as an alternative to solid pre-packaged diets. Furthermore, LIdiet may lead to additional improvements in the compliance of subjects to the diet and also decrease the cost and time of preparation.
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Contact
a.el-chab@brookes.ac.uk

WATER INTAKE AFTER DEHYDRATION MAKES MUSCLES MORE SUSCEPTIBLE TO CRAMP, BUT ELECTROLYTES REVERSE THE EFFECT

LAU, W.Y.1, KATO, H.2, NOSAKA, K.1

1: EDITH COWAN UNIVERSITY (AUSTRALIA), 2: RIKKYO UNIVERSITY (JAPAN)

Introduction
Exercise associated muscle cramp (EAMC) is a painful, involuntary muscle contraction induced during or after exercise. Previous studies (1,2) showed that dehydration did not induce EAMC, and serum electrolyte concentrations increased after dehydration because of hemo-concentration. This study tested the hypotheses that i) water intake after dehydration induced by exercise in the heat would decrease serum electrolyte concentrations and increase muscle cramp susceptibility; ii) intake of beverage containing electrolytes would not change muscle cramp susceptibility; and iii) muscles would become more susceptible to cramp with water intake during exercise, but not with beverage containing electrolytes.
Methods
Ten untrained men (22-31y) performed downhill (-5%) running in the heat (36°C) to reduce the body mass by 1% or 2% in three studies. There were three conditions in Study 1; 1% dehydration, intake of 600-ml spring water at 10 min (A) or 40 min post-exercise (B), or 2% dehydration, intake of 1200-ml spring water at 10 min post-exercise (C). In Study 2, after 2% dehydration, spring water or electrolyte water containing sodium, potassium, magnesium and chloride (OS-1) was consumed at 10 min post-exercise. In Study 3, spring water or OS-1 for the volume corresponding to the body mass loss was taken during exercise. Muscle cramp susceptibility was assessed by threshold frequency (Tf) of electrical train stimulation to induce cramp before, immediately after (0), 45 and 75-80 min after exercise. Blood sample was taken before, 0 and 75-80 min post-exercise to measure serum electrolyte concentrations and osmolarity. Changes in these variables over time were compared between conditions by a two-way repeated measure ANOVA in each study.
Results
Study 1 showed that dehydration itself did not change Tf, but Tf decreased by 2.4-3.1 Hz (1% dehydration) or 3.7 Hz (2% dehydration) after taking water. Serum sodium, potassium, magnesium and chloride concentrations decreased greater from the baseline for the 2% than 1% condition. Study 2 showed that Tf decreased after water intake by 4.3-5.1 Hz, but increased after OS-1 intake by 3.7-5.4 Hz. Serum electrolyte concentrations decreased after water intake, but maintained after OS-1 intake. Study 3 showed that Tf decreased for the water condition by 4.2-4.5 Hz but increased for the OS-1 condition by 11.5-13.6 Hz. Serum electrolyte concentrations were higher ($p<0.05$) for the OS-1 than water condition.
Discussion
These results suggest that water intake after dehydration and during exercise make muscles more susceptible to muscle cramp, probably due to dilution of electrolytes. When fluid containing electrolytes is consumed, the susceptibility to muscle cramp decreases. It seems possible to prevent or attenuate EAMC by consumption of adequate amount of electrolytes.
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Contact
wlau0@our.ecu.edu.au

SWEAT RATE, SWEAT SODIUM CONCENTRATION, CARBOHYDRATE AND FLUID INTAKE IN PROFESSIONAL FEMALE FOOTBALL PLAYERS DURING HIGH INTENSITY TRAINING

TARNOWSKI, C.A.1,2, RANDELL, R.K.1,2, MOSS, S.1, CARTER, J.M.1, ROLLO, I.1,2

1: THE GATORADE SPORTS SCIENCE INSTITUE, 2: LOUGHBOROUGH UNIVERSITY

Introduction
To date only one study has reported sweat rates and sweat composition of professional female football players whilst training. In addition, no study has reported carbohydrate (CHO) intake in professional female footballers during training. Understanding fluid balance and energy intake during different training environments helps inform specific hydration and nutrition recommendations. Therefore, the aim of this observational study was to measure sweat rate, sweat sodium concentration ([Na+]), CHO and fluid intake in professional female football players during a coach-led high intensity team training session.
Methods
Fifteen professional female football players (age: 25 ± 6 years; body mass: 64.2 ± 7.3 kg; stature: 168.5 ± 7.9 cm) participated in a 100 min coach-led high intensity team training session in cool conditions (Temp 13°C; Humidity 72%; WBGT 11°C; Wind speed 3 m/s). Players provided a urine sample prior to training. Urine specific gravity (USG) was recorded as an indicator of pre-training hydration status. Players were weighed before and after the training session in minimal clothing. During the session, players had ad-libitum access to water and a CHO beverage. Sweat [Na+] was determined from regional absorbent patches positioned on the thigh and back using the syringe technique, and analysed by an ion selective electrode device (Horiba B-722). Sweat rate was calculated by assessing the change in body mass from pre- to post- training, as well as fluid intake during the session. Data are shown as mean ± SD.
Results

Pre-training USG was 1.017 ± 0.006. Sweat rate was 0.69 ± 0.33 L/h, ranging from 0.20 – 1.20 L/h, with total sweat losses of 1.15 ± 0.54 L. Sweat [Na+] was 35.0 ± 11.8 mmol/L, with a range of 17.3 – 61.4 mmol/L. This equates to total sweat sodium losses ranging from 204 – 1745 mg (944 ± 508 mg). Total fluid consumption during the training session was 0.75 ± 0.31 L (0.45 ± 0.18 L/h) and CHO intake rate was 3.1 ± 6.0 g/h.
Discussion
The results of the present study show that the sweat rates and sweat [Na+] of professional female football players in cool conditions are low. However, large individual variation exists in both variables. In addition, CHO intake was low and did not meet current sports nutrition recommendations for high intensity training lasting longer than 60 min (30 – 60 g/h).
Contact
caroline.tarnowski@pepsico.com

Oral presentations

OP-PM35 Healthy Ageing

RELATIONSHIP BETWEEN PHYSICAL FITNESS, QUALITY OF LIFE AND SHORT-TERM VERBAL MEMORY IN NURSING HOME RESIDENTS.

RODRIGUEZ, A., REZOLA, C., GIL, S., IRAZUSTA, J., YANGUAS, J., ITURBURU, M., ARRIETA, H.
UNIVERSITY OF THE BASQUE COUNTRY (UPV/EHU)

Introduction
Due to the higher prevalence of chronic conditions along with age-related morbidities in later life, the number of nursing home residents is increasing. The aging process is often associated with functional limitations, disability and has been shown to negatively correlate with quality of life (QoL) (Miyakoshi et al., 2007). Changes in working memory as well as quality of life were associated with positive changes in strength of lower extremities of older adults (Williamson et al., 2009; Hsu et al., 2013). Nevertheless, there is a lack of studies associating physical fitness and cognitive parameters conducted in nursing home residents. In this context, the aim of the present study is to assess the relationship between functional outcomes of institutionalised older people and QoL or short-term verbal memory.
Methods
90 participants from 10 Long-term Residential Care Facilities that met the following criteria: aged ≥ 70 years, scored ≥ 50 on the Barthel Index, scored ≥ 20 on MEC Test (an adapted version of MMSE in Spanish) and who were all capable to stand up and walk independently for 10 metres were included in the study. The studied variables were the 6 test (arm curl, chair stand, 6-minutes walking, chair sit-and-reach, back scratch and 8 foot-up-and-go tests) of Senior Fitness Test battery, QoL-AD Test and Rey Auditory Verbal Learning Test (RAVLT).
Results
A significant correlation was observed between QoL-AD and the results of arm curl ($r=0.407$; $p<0.001$), chair stand ($r=0.286$; $p=0.006$) or 8 foot-up-and-go tests ($r= -0.210$; $p=0.044$). In addition, there was a significant positive association between RAVLT and arm curl ($r=0.341$; $p=0.001$) or chair stand ($r=0.362$; $p<0.001$). 6-minutes walking, chair sit-and-reach and back scratch tests of Senior Fitness Test battery were not associated with QoL-AD and RAVLT ($p>0.05$).
Discussion
This study confirmed the association between QoL and working memory with functional parameters reported by studies conducted in other populations (Williamson et al., 2009; Hsu et al., 2013). Taking into account the association between strength of upper and lower extremities with QoL-AD and RAVLT in nursing home residents, exercise programs focusing on strength training could be appropriate to improve both parameters in this population and to minimize the age-related decline in fitness.
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Contact
haritz.arrieta@ehu.eus

EFFECTS OF A GIANT EXERCISING BOARD GAME INTERVENTION ON AMBULATORY PHYSICAL ACTIVITY AMONG NURSING HOME RESIDENTS: A PRELIMINARY STUDY

MOUTON, A.1, GILLET, N.1, MOUTON, F.1, VAN KANN, D.2, BRUYÈRE, O.1,3, CLOES, M.1, BUCKINX, F.3
UNIVERSITY OF LIÈGE (1,3), UNIVERSITY OF MAASTRICHT (2)

Introduction
Growing evidence indicates that gaming approaches for PA promotion, such as interactive video games, lead to increased enjoyment and motivation next to cognitive and physical positive outcomes (Bleakley et al., 2015). However, active video games are not suitable for every older adult and involve mostly one-on-one supervision (Bieryla et al., 2013). This study examined the effects of a giant (4 meters by 3 meters) exercising board game intervention on ambulatory physical activity (PA) and on a broader array of physical and psychological outcomes among nursing home residents.
Methods
A quasi-experimental longitudinal study design was performed in two comparable nursing homes. Ten participants (82.5 ± 6.3, 6 women) meeting the inclusion criteria took part to the 1-month intervention in one nursing home, whereas eleven participants (89.9 ± 3.1, 8 women) were assigned to the control group in the other nursing home. The giant exercising board game required participants to perform strength, flexibility, balance and endurance activities. Support of an exercising specialist decreased gradually during the intervention in an autonomy-oriented approach, based on the self-determination theory (SDT). PA level (steps/day and energy expenditure/day with GT3X+ ActiGraph), cognitive status (MMSE), quality of life (EQ-5D), motivation for PA (BREQ-2), gait and balance (Tinetti and SPPB), functional mobility (Timed Up and Go) and muscular isometric strength of the lower limb muscles were assessed at baseline, after the intervention and after a follow-up period of three months.
Results and discussion

In the intervention group, PA level increased from 2921 steps/day at baseline to 3358 steps/day after the intervention (+14.9%, p = 0.04) and 4083 steps/day (+39.8%, p= 0.03) after the follow-up period. Energy expenditure/day also increased after the intervention (+110 kcal/day, +6.3%, p = 0.01) and the follow-up period (+219 kcal/day, +12.3%, p= 0.02). Quality of life (p< 0.05), balance and gait (p< 0.05), and strength of the ankle (p< 0.05) were also improved after the follow-up period. Those improvements were not observed in the control group. Those preliminary results are promising but further investigation is required to confirm and evaluate the long-term effectiveness of PA interventions in nursing homes.

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Contact

Alexandre.Mouton@ulg.ac.be

RELATIONSHIP OF COGNITIVE DECLINE WITH SOCIAL ACTIVITY, REGULAR EXERCISE AND PHYSICAL PERFORMANCE AMONG COMMUNITY-DWELLING OLDER PEOPLE IN NORTHERN JAPAN

KOZAKAI, R., UEDA, T., SASAKI, H., IDE, K., HANAI, A., ODA, S., HOMMA, M., KURODA, Y., HONDA, R., OGAWA, H., ODAJIMA, M., AIUCHI, T., OKITA, K.

HOKUSHO UNIVERSITY

Introduction

Cognitive impairment is one of the major concerns for promoting healthy longevity. Previous studies suggested that lifestyle related factors including regular exercise contribute to cognitive function. However, data are still insufficient for clarifying the contributing factors to cognitive impairment in older people. The purpose of the present study was to evaluate the associated factors for cognitive decline among community-dwelling older people in northern Japan.

Methods

The subjects were 97 people aged 60 years and over who participated in the comprehensive study for healthy longevity and completed a cognitive function test in 2015. Cognitive function was assessed by the Mini-Mental State Examination (MMSE). The cut-off points of cognitive decline used the score of 23 and less and that of 27 and less. Social interaction and regular exercise were checked by a questionnaire. Grip strength and 10m maximum walking time were measured using standard techniques. Individual attributes, health conditions and lifestyle were also checked by a questionnaire. The measurements were compared between participants with and without cognitive decline using Chi-square test, Student's-t test and covariance analysis. Significant probability levels were considered to be 0.05.

Results

The number of participants to have <=23 or <=27 of the MMSE score was 7 (7.2%) and 35 (36.1 %), respectively. In the following analyses, the MMSE <=27 score was used as cognitive decline. The participants with cognitive decline were found to be more commonly men, non-workers and those who had a shorter education period. They were less likely to participate in a learning activity and be a user of social network systems. After covariance analysis with age and sex, there was no significant difference in grip strength; however, participants with cognitive decline had significantly longer walking time in sec. than their counterparts (5.9 ± 1.8 vs. 5.4 ± 1.1).

Discussion

Fewer people who tended toward cognitive decline participated in social and intellectual activities such as learning and using internet technology. Walking slower was associated with cognitive decline. However, other social factors, regular exercise and health conditions were not associated with cognitive decline in this study. Our results suggest that social and intellectual activity and walking ability could be an important factor for preventing cognitive decline among community-dwelling older people.

Contact

kozakai@hokusho-u.ac.jp

THE ASSOCIATION OF THE DENSITY OF GROCERY STORES WITH LIFE SPACE AREA AMONG OLDER PEOPLE LIVING ALONE OR LIVING WITH OTHERS

PAVELKA, B.

UNIVERSITY OF JYVÄSKYLÄ

Introduction

Going outside and moving further away from home is associated with higher physical activity and quality of life in older people. Grocery shopping is an important motive to leave home, providing opportunity for physical activity. Living alone or with others may influence where and how often a person is active outdoors.

The aim of the study is to find out the association between the density of grocery stores in the neighbourhood and the life space area in relation to their living circumstances, as of alone or with others in the same home.

Methods

Activity diary and self-report data of 75-90-year-old people living independently in Central Finland were used. Participants of this study (n=533) completed an activity diary on at least four days in a one-week period. Life space categorisation based on self-reports as of home neighbourhood, town or beyond. (Rantanen et al. 2012) A geographic information system was used to determine the density of grocery stores (none, one, two or more) in a circular one-kilometre area around the participants' home.

Results

Of the participants 324 (60.8%) were woman and 209 (39.2%) man, 270 (50.7%) living alone and 263 (49.3%) living with someone. During the study period 20 (3.8%) of the participants stayed within their home neighbourhood, 328 (61.5%) stayed within the town area, and over one third (n=185, 34.7%) visited beyond town borders.

Nonparametric correlation analysis showed that living alone was more common in areas with a higher density of grocery stores (R= -.181, p<.001), and was associated with larger actively used life space areas (R=.194, p<.001). Store density was not statistically significantly associated with life space area (R= -.069, p=.114). When split reference group was analysed, those living alone or with others, none of the associations were statistically significant (p>.074).

Discussion

These results, showing weak associations between living alone, the extent of areas where older people being active and the number of stores located in their neighbourhood, lay grounds for a study on spatially defined activity space based on locations visited by participants and their living circumstances.

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Contact
bela.pavelka@jyu.fi

EFFECTS OF A PHYSICAL ACTIVITY INTERVENTION PROGRAM ON NUTRITIONAL STATUS AND HEALTH-RELATED PHYSICAL FITNESS OF THAI OLDER ADULTS IN BANGKOK METROPOLITAN AREA, THAILAND.

OUTAYANIK, B.1, CARVALHO, J.2, SEABRA, A.2, ROSENBERG, E.3, KRABUANRAT, C.1

1:DEPARTMENT OF PHYSICAL EDUCATION, KU (BANGKOK, THAILAND), 2:FADEUP (PORTO, PORTUGAL), 3:DEPARTMENT OF SOCIOLOGY AND SOCIAL WORK, ASU (NC, USA

Introduction
Aging is frequently associated with a decrease in physical activity levels and consequently a decline in physical fitness, which may contribute to the development of osteoporosis, bone fractures, cardiovascular disease, metabolic syndrome and cognitive impairment (Meijer EP, Westerterp KR, Verstappen FT, 1999; Thygerson A. L. , Larson K. L, 2006; Wang CY, Haskell WL, Farrell SW, Lamonte MJ, Blair SN, Curtin LR, et al., 2010). This study sought to examine the effects of an 8-week physical activity intervention program on nutritional status and health-related physical fitness among Thai older adults.
Methods
Twenty five healthy elderly volunteers in Bangkok metropolitan area (aged 60-75 years) completed an 8-week physical activity intervention that comprises a nine matrices exercise (NME) program (5 sessions per week of 30 - 60 minutes). Measurements were taken at baseline and after 8 weeks, and included height, weight, body mass index (BMI), blood pressure and health-related physical fitness tests (6-minute walk, chair sit-and-reach, arm curl, back scratch, chair stand and 8-ft up and go). Statistical analysis included descriptive statistics and Wilcoxon signed rank test.
Results
Over an 8-week intervention study, participants significantly improved their weight (%Δ = -2.5, $P < 0.001$), BMI (%Δ = -2.5, $P < 0.001$), cardiorespiratory fitness (%Δ = +13.9, p= 0.001), arm curl (%Δ = +45.9, p= 0.001) and leg squat (%Δ = +42.8, p = 0.001) muscular strength, shoulder (%Δ = +9.8, p = 0.006) and lower back (%Δ = +15.0, p= 0.001) flexibility and agility and balance (%Δ = -3.9, p= 0.003). Blood pressure did not change significantly during the study period ($p > 0.05$).
Discussion
This exploratory study examined the effectiveness of a relatively short-term period (8 weeks) of NME program training on nutritional status, blood pressure and physical fitness of healthy, sedentary Thai older adults in Bangkok metropolitan area. The NME program was established for develop a learning program, movements, and the cognitive function of the children (Krabuanrat C, 2009). The tradition nine square model has existed for at least 10 years and is becoming popular in Thailand and can have significant benefits in improving the health-related physical fitness of older adults (Harnirattisai T, Thongtawee B, Raetong P., 2015). In summay, this study provides preliminary evidence that an 8-week NME program represents an effective strategy for improving nutritional status and health-related physical fitness in elderly Thai people.

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Contact
fedublo@ku.ac.th

COMBINED PHYSICAL ACTIVITY AND SEDENTARISM LEVELS ARE RELATED WITH DIFFERENT BLOOD LIPID PROFILES

APARICIO UGARRIZA, R., LUZARDO-SOCORRO, R., PALACIOS, G., BIBILONI, M.M., PONS, A., TUR, J.A., GONZÁLEZ-GROSS, M.

TECHNICAL UNIVERSITY OF MADRID

Introduction
Active people show lower rates of all cause-mortality and lower risk of suffering from cardiovascular diseases (Garber et al. 2011). However, around 40% of the Spanish population claims to be sedentary (EUROSTAT, 2015). Probably, one of the current challenges is to classify people correctly regarding physical activity (PA) and sedentarism. Thus, the aim of this study was to determine the impact of PA and sedentarism in combination on some well described cardiovascular risk factors.
Methods
433 non-institutionalized Spanish older adults (58 % females), aged over 55 years were divided into four groups proposed by Aparicio-Ugarriza et al (2016): IHS (inactive and high sedentary), ILS (inactive and low sedentary), AHS (active and high sedentary) and ALS (active and low sedentary) by cluster analyses. Experimental data were measured by validated questionnaires and fasted blood samples were collected. Total cholesterol (TC), triglycerides (TG), HDL, LDL, LDL/HDL ratio and total homocysteine (tHcy) were analysed. Data was analysed using one-way ANOVA and Kruskal-Wallis tests.
Results
In males, significant differences were observed between IHS and AHS for TG and VLDL ($p<0.01$) and between IHS and AHS and IHS and ALS for HDL ($p<0.01$). TR and LDL/HDL ratio negatively correlated ($p<0.01$) with PA groups and HDL showed a positive and significant correlation in males ($p<0.01$). No differences and associations were observed between PA and sedentarism groups in females.
Discussion
Studies analysing blood lipid profile taking into account a combination between PA and sedentarism classification in elderly population are missing. As sedentarism has emerged as a risk factor for early mortality (Biswas et al. 2015), the combination must be considered in further studies due to the fact that HIS group presented higher levels of tHcy and a worse lipid profile than ALS group. Further studies are

needed to assess the causality of the association of PA and sedentarism on tHcy levels and lipid profile in males and the absence of association in females.

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Contact
raquel.aparicio@upm.es

Oral presentations

OP-PM47 Molecular Biology 3

ALTERED MRNA EXPRESSION LEVELS IN A GENETIC SUSCEPTIBILITY MODEL FOR MUSCULOSKELETAL SOFT TISSUE INJURIES

SEPTEMBER, A.V., WILLARD, K., LAGUETTE, M.J., COLLINS, M.
UNIVERSITY OF CAPE TOWN

Introduction
To date more than 70 loci have been implicated in several musculoskeletal injury profiles. Variants within the COL5A1, BGN, DCN and VEGFA genes were associated with altered susceptibility to ACL ruptures. These genes are implicated in regulating fibrillogenesis and angiogenesis. Moreover, studies have shown that mechanical loading of ligaments induce TGF-1β production which in turn alters the expression of these specific genes, facilitating functional adaption. This study aimed to investigate the mRNA expression of the BGN, COL5A1, DCN and VEGFA genes in healthy individuals with genotypes previously associated with altered susceptibility to ACL ruptures: 1) at baseline and 2) in response to TGF-1β stimulation.
Methods
Skin biopsies were obtained with consent from the participants and used to establish primary skin fibroblast cell lines. Participants were grouped according to their genetic profile for COL5A1 rs12722 and BGN rs1126499 - rs1042103. Total RNA was extracted at baseline (DMEM 10% FBS), serum starved (DMEM 1% FBS) and after TGF-1β treatment (DMEM 1% FBS 10ng/mL TGF-1β). RT-qPCR was performed to determine relative BGN, COL5A1, DCN and VEGFA mRNA expression levels (GUSB: housekeeping gene). All statistical analysis was performed using Statisitica (v13) and significance was accepted at $p<0.05$.
Results
Significant differences were noted at baseline and after TGF-1β treatment. BGN mRNA expression at baseline in the protective group was significantly higher when compared to the risk group (protective: 1.13 arbitrary units (AU), n=8; risk: 0.46 AU, n=10; $p<0.001$). A similar profile was noted for COL5A1 (protective: 1.03 AU, n=8; risk: 0.55 AU, n=10; $p<0.001$) and VEGFA (protective: 1.02 AU, n=8; risk: 0.52 AU, n=10; $p=0.001$) at baseline. COL5A1 mRNA expression in the TGF-1β treated cultures was significantly higher in the protective group compared to the risk group (protective: 5.81 AU, n=8; risk: 4.59 AU, n=10; $p=0.010$) and a similar profile was noted for VEGFA (protective: 3.43 AU, n=8; risk: 2.45 AU, n=10; $p=0.001$).
Conclusion
This study showed altered mRNA levels for BGN, DCN, COL5A1 and VEGFA to be associated with the genetic susceptibility profiles at baseline and after TGF-1β treatment. This model provides preliminary functional evidence for the previous genetic loci implicated with susceptibility to musculoskeletal soft tissue injuries.

HYPERTROPHY OF HUMAN SKELETAL MUSCLE CELLS IN RESPONSE TO IN VITRO ELECTRICAL-PULSE-STIMULATION EXERCISE MODEL

TARUM, J., FOLKESSON, M., ATHERTON, P.J., KADI, F.
ÖREBRO UNIVERSITY

Introduction
Electrical Pulse Stimulation (EPS) of cultured human muscle cells has been previously established as an in vitro exercise model. In muscle cells exposed to EPS, lactate release (Scheler et al., 2013, Nikolic et al., 2012), reduction in ATP and phosphocreatine levels (Nedachi et al., 2008, Nikolic et al., 2012), increased oxidative capacity (Feng et al., 2015, Burch et al., 2010) and improved insulin sensitivity (Feng et al., 2015, Nikolic et al., 2012) have previously been demonstrated. The use of EPS as a model able to induce the hypertrophy of human muscle cells has never been documented. The present study aims to discover the effects of EPS on molecular machinery responsible for the hypertrophy of human muscle cells.
Methods
Cultured human myotubes were exposed to electrical pulse stimulation. Immunohistochemistry, RT-PCR and western blotting were performed to investigate changes in muscle cell morphology, protein and gene expression of key factors involved in regulation of muscle mass. The exercise-related myokine IL-6 secretion was measured using ELISA.
Results
An EPS protocol consisting of bipolar pulses of 2ms at 12V with the frequency of 1Hz for 8 hours induced a significant release of the myokine IL-6 ($p<0.05$) and increase in the size of human myotubes compared to non-stimulated muscle cells ($p<0.05$). This was accompanied by significant downregulation of myostatin ($p<0.05$) mRNA levels. EPS-induced elevation of phospho-mTOR ($p<0.05$) and phospho-4E-BP1 ($p<0.05$) indicated an EPS-mediated upregulation of protein synthesis machinery. We further show that the inhibition of protein synthesis using cycloheximide abolished the hypertrophic effects induced by EPS.
Discussion
Here we demonstrate for the first time that EPS can induce the hypertrophy of human skeletal muscle cells, which makes it an appropriate in vitro exercise model mimicking human skeletal muscle adaptation to resistance training.

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THE EFFECTS OF TFAM EXPRESSION BY ENDURANCE EXERCISE TRAINING ON AMPK, PPAR Β/Δ AND PGC-1Α IN MOUSE SKELETAL MUSCLE

KIM, K., KOH, J., AHN, N., PARK, J., LEE, K.
KEIMYUNG UNIVERSITY

Introduction
Tfam overexpression has been shown to increase mitochondrial biogenesis and respiratory function (Ekstrand et al., 2004; Canugovi et al., 2010), but there is not clear how Tfam signals to the nucleus, and that a key factors associated with muscle adaptation are involved in Tfam overexpression by endurance exercise. The aim of this study was to identify the effects of Tfam expression by endurance exercise on AMPK, PPARβ/δ and PGC-1α that are associated with skeletal muscle adaptive response.
Methods
Mice were subjected to the forced swimming for 2 week or Tfam was electroporated in tibialis anterior (TA) muscle. To identify PPARβ/δ effect on Tfam, PPARβ/δ was electroporated in PGC-1α knockout mouse muscle. Mice Swimming for 2 wk result in an increase Tfam, PPARβ/δ and PGC-1α in TA muscle.
Results
Endurance exercise raining group showed a significant higher expression of PPARβ/δ and PGC-1α in skeletal muscle. Tfam overexpression in mouse TA muscle induced in an increase AMP:ATP ratio, AMPK phosphorylation, PPARβ/δ and PGC-1α expression. PPARβ/δ overexpression in PGC-1α knockout muscle in mouse result in an increase Tfam expression.
Discussion
Endurance exercise could be drive the activation of AMPK and PPARβ/δ (Fillmore et al., 2010; Koh et al., 2016). Our finding indicate that an increased Tfam expression by endurance exercise increases AMPK activation through controled AMP:ATP ratio that result in an increase PPARβ/δ and PGC-1α expression. These results indicate that Tfam can increase itself through AMPK-PPARβ/δ and/or PGC-1α axis.
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Contact
kjk744@kmu.ac.kr

Oral presentations

OP-PM42 Exercise and cancer

LIBRE- PILOT: FEASIBILITY AND RESULTS OF STRUCTURED ENDURANCE TRAINING IN BRCA1 AND BRCA2 MUTATION CARRIERS

BERLING-ERNST, A.1, KIECHLE, M.2, DUKATZ, R.2, YAHIAOUI-DOKTOR, M.3, BASRAI, M.4, HALLE, M.1,5,6
1 DEPARTMENT OF PREVENTION AND SPORTS MEDICINE, KLINIKUM RECHTS DER ISAR (MRI), TECHNICAL UNIVERSITY MUNICH (TUM) 2 GYNECOLOGY AND CENTER FOR HEREDITARY BREAST AND OVARIAN CANCER, MRI, TUM

Introduction
BRCA1/2 germline mutations carrier have an increased risk for breast and ovarian cancer that seems to be modified by physical activity and healthy nutrition. Studies in non-mutation carrier show an average breast cancer risk reduction about 25% for women who are being physical active.
Methods
Healthy and diseased women with pathogenic BRCA1/2 mutations (n=68) were randomly assigned to an exercise (IG: n=33) and a control (CG: n=35) group. The IG received a structured nutrition course and individualized endurance training (2x/week supervised, 1x/week unsupervised, 60-75% of VO2peak), aiming at reaching 18 MET-h/week within the first 3 months. Monthly group training and nutrition sessions were maintained for the following 9 months. The CG attended one session on healthy nutrition and information about the benefits of physical activity, but no training. At the beginning, after 3 and 12 months both groups were examined with treadmill tests (ramp protocol) to investigate peak oxygen uptake (VO2peak) and ventilatory threshold (VT1), in addition to physical activity questionnaire (IPAQ) and accelerometer (Physical Activity Level PAL). Primary endpoints are feasibility, compliance and acceptance of the intervention over 12 months. Secondary endpoints are changes in physical fitness (VO2peak, VT1), physical activity (PAL) and body mass index (BMI) over 12 months.
Results
68 females (mean age = 41, mean BMI = 23.2 kg/m2) were included. 81% (IG: n=26; CG: n=29) finished the study. 21 individuals in IG participated in at least 70% of training sessions, half of them (n=11) reached a physical activity level of 18 MET-h/week within the first 3 months. Individuals in IG improved their VT1 (14 to 15 ml/kg/min), the CG VT1 decreased (16 to 15 ml/min/kg) within the first 3 months (p=0,038). Comparing PAL Data between IG and CG, IG improved significantly within 12 months (p=0,043).

Discussion
The lifestyle intervention was feasible, safe and well accepted. Furthermore, improved VT1-Levels of IG assumes beneficial effects of this exercise training to BRCA1/2-carriers. The higher PAL-Level of IG after 12 months may imply long-term effects of this intervention.
Contact
berling@sport.med.tum.de
Trial registration (ClinicalTrials.gov): NCT02087592

THE PHYSICAL ACTIVITY AND FITNESS IN EUROPEAN CHILDHOOD CANCER SURVIVORS STUDY – EUROPACCS

GRYDELAND, M.3, LIE, H.C.1,4,5, THORSEN, L.4, RAASTAD, T.3, STENSRUD, T.2, MATTHEWS, I.L.1, ANDERSSEN, S.A.2, RUUD, E.1

NORWEGIAN SCHOOL OF SPORT SCIENCES

Introduction
Childhood cancer survivors (CCSs) are at risk of treatment-associated late effects such as cardiovascular disease, obesity, diabetes and early mortality compared to healthy peers. Physical activity (PA) may reduce these risks and improve quality of life (QoL). However, within this field quality evidence from large-scale studies is lacking. Therefore, the aims of EuroPACCS are to extensively survey European CCSs' levels of PA, fitness and QoL using clinical, objective and self-reported measures, as compared to healthy controls.
Methods
We aim to recruit >400 CCSs aged 9-15 years attending routine follow-up consultations after any previous malignant disease ≥1 year after ended anti-cancer treatment. PA is assessed by ActiGraph™ accelerometers. QoL, perceived barriers/facilitators to PA, health-related behaviors, fatigue and psychosocial adjustment are assessed by questionnaires. Physical fitness (PF) will be assessed clinically and physiologically in a subgroup of 100 CCSs (e.g. cardiorespiratory fitness, muscular strength and body composition). A pilot study was conducted in Nov2016-Feb2017 in Oslo Norway (not including PF measures).
Results
The pilot sample consisted of 27 CCSs (12 females), response rate was 87%, mean age 12.4 (SD=2.2) yrs, mean time since treatment 6.8 (2.6) yrs, 67% was treated for leukemia. Mean PA levels were 481 (131) counts per minute (cpm) for girls and 474 (163) for boys. PA (cpm) correlated negatively with time since treatment (rho=-0.51, $p<0.05$). QoL correlated highly with fatigue and self-rated health, but not with PA (cpm) in this small sample.
Discussion
The pilot study indicates that the EuroPACCS study is feasible. The CCSs have somewhat lower levels of PA than healthy age matched controls (Kolle et al, 2012). Knowledge of the PA level, physical capacity limitations and perceived barriers and facilitators to PA among CCSs can aid the development of a safe and efficient intervention.
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Contact
may.grydeland@nih.no

EVALUATING PHYSICAL FUNCTION IN CHILDREN WITH CANCER DURING INTENSE TREATMENT –CHALLENGES AND FEASIBILITY IN CLINICAL PRACTICE

NIELSEN, M.K.F., CHRISTENSEN, J.F., SCHMIEGELOW, K., THORSTEINSSON, T., ANDERSEN, L.B., LARSEN, H.B.

COPENHAGEN UNIVERSITY HOSPITAL, RIGSHOSPITALET

Introduction
Childhood cancer is associated with a 5-year relative survival rate of more than 80%, yet the prognostic progress has considerable costs. Children with cancer exhibit reduced physical function early in the treatment that often remains a problem years after cessation of treatment. The "Rehabilitation including Social and Physical activity and Education in Children and Teenagers with Cancer" (RESPECT) study investigates the capacity of a multimodal rehabilitation intervention initiated from the point of diagnosis. RESPECT is based on the hypothesis that; it is easier to maintain the child's physical function than to regain potential deficits. Here, we report data describing feasibility and barriers related to evaluation of physical function in children with cancer during the early treatment phase.
Methods
Seventy-five children (61.3% boys, aged 6-18 years [mean age: 11.3 ±3.1 y]) diagnosed with acute leukemia (41%), lymphoma (19%), extracranial solid tumors (28%) and CNS tumors (12%) were included in study. At the point of diagnosis and after three months treatment, participants were scheduled to perform a test-battery including timed up and go (TUG), sit-to-stand (STS), flamingo balance, handgrip strength and cardiopulmonary exercise test (CPET) on a bicycle ergometer.
Results
Of 75 children included in the study, 69 (92%) completed at least one test during the first 3 months of treatment which included adherence rates of 66.7% for TUG, 71.3% for STS, 77.3% for flamingo-balance and 80.7% for handgrip strength. CPET was associated with significant barriers, and only 25.3% of all tests (at diagnosis and 3 months) were completed. Of all uncompleted CPETs, 80.4% were due to medical restrictions (e.g. physician restrictions and side effects), 8% were due to child´s motivational reasons and 11.6% were due to logistic reasons. In total, 607 tests were completed and one serious adverse event was observed, with one child who fainted briefly after CPET. Preliminary results show no difference in VO2Peak at diagnosis and 3 months with values of 28.1 +- 6.5 mL/kg/min and 27.1+-6 mL/kg/min, respectively.
Discussion
Evaluation of physical function in children with cancer is safe and generally feasible and the children were motivated to participate. However strenuous tests such as CPET are accompanied by several barriers such as physician restrictions and treatment-related side effects. Children with cancer can perform CPET and the preliminary results suggest that VO2Peak are unchanged from diagnosis to 3 months. This suggests that CPET data from the early treatment phases can be pooled, thus increasing the adherence rates.

EVALUATION OF A HOME-BASED PHYSICAL ACTIVITY INTERVENTION USING ACTIVITY TRACKERS IN PEDIATRIC CANCER PATIENTS

GÖTTE, M., KESTING, S.V., ROSENBAUM, D., BOOS, J.
UNIVERSITÄTSKLINIKUM MÜNSTER

Introduction
Recent studies suggest positive effects of supervised in-hospital exercise programs on physiological and psychological parameters (Braam et al., 2016; Götte et al. 2014). Additional exercise promotion during home stays has the potential to increase effects but feasible concepts are missing. This study evaluated a home-based intervention using individually tailored exercise plans and activity trackers (Fitbit®) to guarantee supervision and control. Outcomes were adherence to goals for steps and active minutes and effects on motor performance and health related quality of life (hrQoL).
Methods
This study included 40 patients in total (14.7 ± 3.9 yrs., 35% leukemia, 28% lymphoma, 25% bone tumors, 13% others). The intervention group (n=21) received a six-to-eight week intervention during intensive treatment (T1) and a two-week intervention in transition to maintenance therapy or aftercare (T2). The control group (n=19) only received the intervention at T2. Baseline tests to assess motor performance, physical activity and psychological aspects were conducted before every intervention. Satisfaction with the intervention and general opinions were evaluated in guided interviews.
Results
Participants in the intervention group significantly improved adherence to their individual step goals during the study period (T1: 38.5%, T2: 51.7%, p=0.04), whereas adherence to active minutes remained low (T1: 9.5%, T2: 15.8%, p=0.23). The intervention group scored higher in hrQoL global score and the sub scores physical well-being and self-esteem (p<0.01 each) but no significant differences in motor performance were seen. However, the percentage of children scoring below normative value was higher in the control group in all strength tests (handgrip, leg strength, explosive strength). 94% of all participants rated the intervention as meaningful and 80% as motivational for increasing physical activity whereof 23% recognized decreasing motivational effects over time.
Discussion
Overall the intervention was safe, well accepted by the patients and adherence to step goals seem to increase after cessation of acute therapy. The intervention group rated their hrQoL considerably higher at the end of treatment. Particularly self-esteem was significantly improved which may be due to the program that is based on achievement of goals and self-administered exercise. Home-based exercises however did not seem to have a large beneficial effect on motor performance which might be due to compliance problems or insufficient intensity. Results of this study indicate that such exercise interventions for home stays under decentralized supervision are feasible and beneficial for children with cancer. Besides positive effects on hrQoL, further strategies are needed to increase effects on motor performance.
Contact
boos@ukmuenster.de

CHANGES IN MUSCLE STRENGTH DURING THE FIRST YEAR OF TREATMENT FOR CHILDHOOD CANCER IN A SAMPLE OF CHILDREN TAKING PART IN A CLINICAL EXERCISE INTERVENTION

SÖNTGERATH, R., WULFTANGE, M., CHRISTIANSEN, H.C., KRAMP, V., ECKERT, K.
LEIPZIG UNIVERSITY

Introduction
Childhood cancer patients (CCP) are often faced with impairments in physical performance (PP), especially muscle strength, due to treatment related physical inactivity and side effects of medical treatment (Söntgerath & Eckert, 2015). Thus, targeted exercise interventions have been recommended to address these impairments (Baumann et al., 2013). A study was conducted to evaluate the feasibility of a clinical exercise intervention and to characterize impairments described during the first year of treatment. Results in measurement of muscle strength are presented.
Methods
Maximum voluntary muscle strength was evaluated every three months (mo) following diagnosis (+0mo, +3mo, +6mo, +9mo, +12mo) using a hand-held dynamometer. Children age 6-18 years with a diagnosis of cancer receiving standard chemo- and/or radiation therapy were included. Elbow flexion and extension, hip flexion, knee flexion and extension and ankle dorsiflexion were evaluated. Peak values for the left and right side of three measurements were combined to a mean value and compared to reference values of healthy gender and age matched children (Beenakker et al., 2001). Group standard deviation scores (SDS) were calculated to visualize the change over time in muscle strength.
Results
20 CCP (10 male) with mixed diagnoses were evaluated (median age 15 years). Exact Wilcoxon tests show statistically significant impairments of muscle strength (p = .000 - .04) compared to references at all measurements except for elbow extension at +12mo. Effect sizes indicate a great effect with r = .44 - .88. SDS show high negative deviations from reference values especially at measurements +0mo, +3mo and +6mo and slight approaches towards references at +9mo and +12mo (median group SDS at +0mo -0,8 to -2,8; at +3mo -1,1 to -2,9; at +6mo -1,1 to -3,1; at +9mo -1,0 to -2,8; at +12mo -0,7 to -2,0). Lower extremity strength, especially knee flexion and ankle dorsiflexion, show greater impairment compared to upper extremity.
Discussion
CCP show severe impairments of muscle strength during treatment with a slight recovery with transition to maintenance or aftercare despite taking part in the exercise intervention and a 4-week stationary rehabilitation program. Targeted programs to promote physical activity and enhance PP need to be accessible for patients during and after treatment to prevent persistence of impairments and support reintegration into school physical education and recreational sports.
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Contact
Regine.Soentgerath@medizin.uni-leipzig.de

Oral presentations

OP-PM34 Acute responses to exercise

INDIVIDUAL STRESS RESPONSES TO DIFFERENT TRAINING LOADS IN ENDURANCE ATHLETES

HAKKARAINEN, A.1, OHTONEN, O.1, NIKOLA-MÄÄTTÄ, S.1, HARMAALA, A.1, SIMULA, J.1, LEPPÄVUORI, A.1, HYNYNEN, E.2, LINNAMO, V.1

1: UNIVERSITY OF JYVÄSKYLÄ, FINLAND, 2: KIHU - RESEARCH INSTITUTE FOR OLYMPIC SPORTS, JYVÄSKYLÄ, FINLAND

Introduction
Short time heart rate variability measurements are widely used to evaluate the level of stress and can thus give valuable information in planning the training programs for athletes (Plews et al., 2013). Many coaches and athletes also use Checkmylevel (CML) in order to assess personal readiness. The aim of the present study was to examine if the differences in orthostatic test and jumping performance between easy and hard training week are related to differences observed with CML.
Methods
Six male and two female endurance athletes (17.0 ± 0.8 years) participated in the study. Measurements were conducted during EASY and HARD week which consisted of 1.48 ± 0.4 and 1.95 ± 0.5 training hours collected by Polar Flow per day, respectively. Orthostatic test with Polar V800 (Polar Electro Oy, Kempele, Finland) heart rate monitor and measurement with Checkmylevel (Juno Medical Oy, Oulu, Finland) were done each morning during both weeks and the average value of successful measurements during both weeks were used for further analysis. In addition, four of the subjects performed a counter movement jump (CMJ) and static jump test at the beginning of each week.
Results
No significant differences were observed between EASY and HARD week. During orthostatic test maximal heart rate was 0.5 ± 3.3% lower in HARD, average heart rate during rest 1.9 ± 4.1% and during standing 4.2 ± 7.5% higher in HARD. RMSSD reflecting cardiac autonomic modulation during rest was 2.1 ± 14.3% higher and during standing 21.3 ± 18.1 lower in HARD. Static jump was 3.1 ± 4.7% lower and CMJ 0.2 ± 7.3% higher in HARD. Intensity (mA) needed to evoke a response for CML was 46.7 ± 124.1% higher in HARD. Significant correlations were found in the difference (EASY vs. HARD) between CML and peak heart rate ($r=0.81$, $P<.01$), heart rate at rest ($r=0.69$, $P<.05$), RMSSD rest ($r=-0.80$, $P<.01$) and static jump ($r=0.96$, $P<.05$).
Discussion
Even though the training load was clearly higher during the HARD week only some of the athletes showed signs of stress as measured with the current variables emphasizing the importance of individual training response. Correlations found between the differences observed in CML and heart rate variables indicate that CML may be connected to behaviour of the autonomic nervous system. Change in CML correlated with the change in jumping performance indicating that CML may be sensitive to changes also in neural/muscular level. Both commercial systems offered some technical challenges that inhibited to get the values easily on a daily basis.
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Contact
anni.s.j.hakkarainen@jyu.fi

A PHYSIOLOGICAL PROFILE OF THE STRESS RESPONSE FOLLOWING RESISTANCE EXERCISE

JACKMAN, J., COCKBURN, E.

MIDDLESEX UNIVERSITY

Introduction
A variety of strategies exist to decrease the stress placed upon skeletal muscle during and following exercise to accelerate recovery processes. For individuals looking to optimise training programming and recovery strategies, an understanding of the stress imposed by exercise would be beneficial. Therefore, the aim of this study was to provide a physiological profile of the stress response following resistance exercise.
Methods
Using a within-subject design, 8 resistance-trained males (age=21±3 years, height=1.81±0.8 m, body mass=82.0±8.0 kg, back squat 6 repetition maximum [RM] =1.2±0.2 xbody mass) were recruited. Across two separate weeks, participants performed either a control (week one) or exercise (week two) session with assessments conducted at baseline, 2h, 6h, 24h, 48h, 72h and 96h post-intervention for each week. The exercise intervention consisted of 4 sets of 6 repetitions at 6 RM for four lower limb exercises, while a time-matched rest period characterised the control intervention. Maximal voluntary isometric contraction (MVIC), 20m sprint, countermovement jump (CMJ), muscle soreness, creatine kinase (CK), high sensitivity C-reactive protein (hsCRP) and interleukin-6 (IL-6) were assessed. Data were analysed by making probabilistic magnitude-based inferences about the difference between the control and exercise weeks (mean effect±90% CI), with blood variables presented as factors (Batterham & Hopkins, 2006).
Results
Exercise most likely decreased MVIC at 2h (-19.5±5.0%), and was still very likely decreased at 6h and 24h post-exercise, compared to the control week. Sprint performance was very likely impaired at 2h (4.1±2.3%) which was still evident at 6h post-exercise, compared to the control week. Muscle soreness was very likely elevated at all time points from 2h to 72h post-exercise, with a peak at 24h (102.8±29.3mm), compared to the control week. IL-6 very likely increased at 2h and continued to rise until 6h post-exercise (2.97x/÷2.39), compared to the control week. hsCRP and CK were very likely increased at 24h (1.71x/÷1.33; 1.98x/÷1.63, respectively), compared to the control week. Differences in CMJ were unclear between weeks.
Discussion
Resistance exercise resulted in muscle cell disruption, acute-phase inflammation and muscle soreness which concomitantly impaired muscle function and performance. Aspects of this response were evident as soon as 2h post-exercise and may continue to affect the

individual for up to 72h post-exercise. For trained individuals looking to manipulate the stress imposed by resistance exercise, this study provides information as to the profile of the time course and extent of the response.
Reference
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Contact
J.Jackman@mdx.ac.uk

ACUTE PHYSIOLOGICAL RESPONSES TO RESISTED SLED SPRINT TRAINING AT LIGHT OR HEAVY SLED LOADS

MONAHAN, M.1., PETRAKOS, G.2., DITROILO, M.1., EGAN, B.3
UNIVERSITY COLLEGE DUBLIN

Introduction
Sprint acceleration is a key component of physical performance in field sports. While the benefits of resisted sled sprinting (RSS) to sprint acceleration are clear (Petrakos et al, 2016), the acute physiological and performance responses to individual RSS training sessions remain unknown. The primary aim of this study was to elucidate the acute physiological (blood lactate [BLa], heart rate [HR]), perceptual (ratings of perceived exertion [RPEs], perceived level of muscle soreness [PLMS]) & performance (Countermovement jump [CMJ] jump height [cm], sprint speed [s] 0-10m [10s] & 0-20m [20s]) responses to RSS training sessions of either light or heavy sled loads.
Methods
Field sport athletes (n = 27; 12 M, 15 F; age, 21.1 ± 2.7 y; body mass, 70.5 ± 14.9 kg) completed the study for which all sessions took place on an indoor tartan track. The first testing session established Maximal Resisted Sled Load (MRSL) (Martinez-Valencia et al, 2014) from which light and heavy loads were prescribed 30% (L) and 80% (H) of MRSL, respectively. The main trials entailed training sessions of 12 x 20m RSS repetitions, at either L or H and an assessment battery for the variables described above was performed prior to (Pre), after (PT) & 24h after (+24) each session.
Results
The sled load at L and H averaged 12%BM and 32%BM, respectively. No differences between conditions were observed when performance responses to L & H were compared. Assessment within condition over time showed decrements in all performance measures at LPT and HPT. Decrements in 10s & 20s were small; L (d=-0.3) and H (d=-0.2), while decrements in CJM showed a large effect at L-PT (d=1.44) and a moderate effect at H-PT (d=0.78). No performance decrements remained +24. B-La levels rose significantly, 30% & 88% during L & H respectively, levels returned to Pre at LPT but remained elevated at HPT ($p<0.001$). HR did not significantly change above 'working' in response to sprint efforts. RPE showed a positive linear increase for time during L & H. When comparing load specific responses over time, H had a greater effect on physiological measures PT; Final B-La 54% (d=-1.2), B-La 57%, (d=-1.2), Average HR 9% (d=-1) & Session RPE 43%(d=-1.5) difference from L.
Discussion
RSS training appears to acutely fatigue an athlete, but no residual fatigue appears +24 maybe due in part to RSS protocol permitting HR recovery between bouts (3min inter rep rest). Heavier RSS load provides a superior metabolic effect, H causing a moderate to larger increases in B-La, HR & RPE compared to L, without a comparable increase in muscle soreness. Possibly due to reduced eccentric activity as RSS load increases.
Conclusion
A RSS training session of up to 60% BM in a 12 x 20m pattern can occur 24h prior to sprint acceleration or jump training without reduced training quality.
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Contact: maria.monahan@ucd.ie

IS HEART RATE VARIABILITY A USEFUL TOOL TO ASSESS PHYSIOLOGICAL RESPONSES TO AN ACUTE TRAINING OVERLOAD IN YOUTH FEMALE ROWERS?

EGAN-SHUTTLER, J., IVES, I.S., EDMONDS, R.
SKIDMORE COLLEGE

Introduction
Heart rate (HR) variability (HRV) is a reliable indicator of cardiac parasympathetic activity and has been used in athletic populations to measure training adaptations. To date, there is limited research showing whether HRV is practical in youth female athletes and rowers during short periods of overload training. The purpose of this study was to document HRV changes due to training load variations, and to evaluate the practicality of HRV in documenting training responses of youth female rowers during a training camp.
Methods
Time domain (standard deviation of RR intervals, SDNN; root mean square of successive differences, RMSSD) and nonlinear (SD1) indices of HRV were recorded during baseline training, daily during the six-day training camp, and one week after the camp in 5 athletes from an elite high school rowing team. Training duration and rate of perceived exertion (RPE) were recorded to document training load.
Results
Training load during the camp was 76% above the athlete's normal workload (2258, s = 459 vs 1280, s = 356). Cardiac vagal activity (RMSSD and SD1) was very likely reduced during each day of the camp when compared with normal training, though returned to baseline within a week of the training camp. Interestingly, SDNN was reduced throughout the training camp and remained reduced up to a week after the training camp (78/16/4, ES=-0.32).
Discussion
These insights add value to the use of HRV in youth sport and provides coaches with an easy and cost-effective means to monitor the physiological response to training load, allowing fine-tuning for performance.

METABOLIC RESPONSE DURING SUBMAXIMAL AND MAXIMAL ERGOMETER TESTS IN ELITE SPRINT KAYAKERS

ELGH, T.1, LINDBERG, T.1, BJÖRKLUND, G.1,2

1: THE SWEDISH SPORTS CONFEDERATION, STOCKHOLM, SWEDEN, 2: STRC, MID SWEDEN UNIVERSITY, ÖSTERSUND, SWEDEN

Introduction
Kayaking is a sport that comprises different distances. For propulsion of the kayak there is a mix of aerobic and anaerobic energy contribution with an increased anaerobic demand at the shorter distances. The total anaerobic contribution has previously been estimated (Zouhal et al., 2012) however not different sections of the race. Furthermore, the effectiveness to transfer metabolic power to propulsion is of importance for kayaking. Therefore, the aims were to quantify the anaerobic contribution throughout a time-trial (TT) as well as quantify gross efficiency (GE) at submaximal intensities.
Methods
10 male elite sprint kayakers participated in the study (age 25±3 years, height 188.1±5.9 cm and body mass 93.3±6.8 kg). Each athlete performed 4-5 individualized 4-min submaximal steps (10-20 w/step) with 1-min rest in between on a kayak ergometer (Dansprint Pro, Denmark). 10 min after, a 4-min TT was performed. Oxygen consumption was measured continuously in a BxB mode. After each submaximal step and the TT, blood samples were taken (20 µL) and analyzed for lactate concentration. Power output was evaluated with a software (Moebius, Dansprint analyzer 1.12, Denmark). GE was calculated for computation of accumulated oxygen deficit (AOD).
Results
GE improved with increased submaximal intensity at the step test (11.15, 11.34, 11.41 and 11.57%) ($F_{3,27}=4.4$, $p<0.04$). During the TT the total anaerobic input was 12.8±4.0 (ml/kg) and the anaerobic contribution was highest during the 1st min and lowest during the 3rd min (63, 8, 2 and 5% respectively) ($F_{3,27}=202$, $p<0.001$). Post blood lactate values was highest during the 3rd compared to the 1st min ($p<0.01$). Relative power output during TT was related to GE at submaximal intensities ($r=0.75$-0.82, all $p<0.05$) while absolute power output was associated to VO2max ($r=0.51$, $p<0.05$).
Discussion
The AOD during the TT was higher than previously reported during a simulated 1000 m on open water. Further the kayakers in current study displayed an inversed J-shaped pacing curve. This demonstrate that kayakers expands their anaerobic capacity more or less during the first minute. Interestingly, kayaking is considered to be highly anaerobic sport however current results show that this is true mainly in the first section of the TT. The magnitude of the anaerobic contribution during the start was not related to performance. The small but essential increase in GE with increased workload and the association between GE and relative power output shows that kayaking performance heavily depend on an effective movement pattern.
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Contact
Tobias.elgh@rf.se

Oral presentations

OP-BN18 Neuromuscular aspects of strength

EFFECTS OF 4-WEEKS OF LOCAL VIBRATION TRAINING ON KNEE EXTENSION FORCE PRODUCTION AND CORTICAL VOLUNTARY ACTIVATION IN ELDERLY AND YOUNG POPULATIONS

SOURON, R., BESSON, T., LAPOLE, T., MILLET, G.Y.

UNIVERSITÉ JEAN MONNET (SAINT-ETIENNE)

Introduction
Local vibration (LV) has been proposed as a neuromuscular rehabilitation technique. The significant strength improvement recently showed after 14 days of LV training on the Achilles tendon have been suggested to be due to spinal and/or supra-spinal adaptations (Lapole, Canon et al. 2013). In the current study, it was hypothesized that a 4-week local vibration training (total: 12 sessions 1 h) will increase i) maximal voluntary contraction (MVC) and ii) cortical voluntary activation (VATMS) assessed by transcranial magnetic stimulation (TMS) for knee extensor muscles in elderly and young subjects. Since aging is associated with neuromuscular deconditioning (Baudry 2016), it was also hypothesized that the gains would be greater in the elderly than in the young population.
Methods
Seventeen healthy subjects (n = 9 and n = 8 for young and elderly subjects, respectively) participated in this study. Force measurements were performed during voluntary isometric knee extension with knee angle fixed at 90°. During MVCs, the use of TMS allowed VATMS assessment as follow: VATMS = (1-[SITMVC/ERT]) × 100
where SITMVC is the superimposed twitch evoked during MVC, and ERT the estimated resting twitch determined by linear regression of the relation between SIT amplitude evoked when TMS was delivered at 100, 75 and 50% MVC and voluntary force. This relation was then extrapolated and the y-intercept was interpreted as the ERT amplitude.
Results
When pooling young and elderly subjects, MVC was increased after the 4 weeks of local vibration training (+11.8 ± 8.0%, $p<0.001$). VATMS was also significantly increased (+3.6 ± 5.1%, $p=0.002$). No significant differences were found between young and elderly groups in the strength or VATMS gains.
Discussion
Local vibration training seems to be an effective method to induce strength gains in both young and elderly people. Corticospinal adaptations play a role in these adaptations. However, the hypothesis that elderly would present greater gains than young subjects was not confirmed.
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RAPID UTILISATION OF AVAILABLE MAXIMUM STRENGTH IN EXPLOSIVE EFFORTS IS INFLUENCED BY CONTRACTION TYPE AND SPEED

TILLIN, N.A.1, PAIN, M.T.G.2, FOLLAND, J.P.2

1: UNIVERSITY OF ROEHAMPTON; 2: LOUGHBOROUGH UNIVERSITY

Introduction

The ability to rapidly increase torque and utilise the maximal voluntary torque (MVT) available at a given joint angle and velocity is greater in concentric than isometric or eccentric explosive contractions (Tillin et al., 2012). This effect may be further delineated by contractile speed. This study investigated the effects of contraction type and speed on the ability to rapidly utilise the available MVT, and the neuromechanics underpinning any effects.

Methods

Fourteen males performed explosive voluntary knee extensions ('fast and hard') on an isokinetic dynamometer in 5 conditions; isometric (ISO; knee angle 123°), concentric slow (CONSLOW) and fast (CONFAST), and eccentric slow (ECCSLOW) and fast (ECCFAST). CON and ECC were performed at constant accelerations of 500°.s-2 (SLOW) or 2000°.s-2 (FAST), from a stationary 89° (CON) or 156° (ECC) knee angle. Torque was recorded every 25 ms up to 150 ms from torque onset, and normalised to MVT specific to the joint angle and velocity at the same time point. Quadriceps EMG amplitude was also recorded every 25 ms up to 150-ms from EMG onset, and normalised to EMG at MVT specific to the joint angle and velocity at the same time point. Torque data were entered into a Hill-type muscle model (Pain & Forrester, 2009) to determine the condition effects on muscle fibre force.

Results

Normalised explosive torque at all measured time points was on average 51% greater in CONFAST than CONSLOW ($p<0.001$), 25% greater in CONSLOW than ISO ($p=0.041$), similar in ISO compared with ECCFAST ($p=0.472$), and 33% greater in ECCFAST than ECCSLOW ($P=0.092$). After 150 ms of contraction, torque was at 100% MVT in CONFAST, but in the other conditions was only 73% (CONSLOW), 61% (ISO), 59% (ECCFAST), and 42% MVT (ECCSLOW). Normalised explosive EMG at all measured time points was on average 120-141% greater in CON and ISO compared to ECC conditions ($p\leq0.001$), but similar between slow and fast conditions within the same contraction type. The condition effects on muscle fibre force were almost identical to those reported above for torque.

Discussion

The ability to rapidly utilise available MVT was affected by both contraction type and speed, and greatest in CONFAST, followed by CONSLOW, ISO, ECCFAST and ECCSLOW. Neural activation was affected by the type (greatest in CON and ISO) but not the speed of contraction within the same contraction type, so appears to contribute to the effects of contraction type but not speed, on normalised explosive torque. The effects of contraction speed instead appear to reflect the intrinsic contractile properties of the muscle fibres.

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Contact

Neale.tillin@roehampton.ac.uk

MODULATION OF H-REFLEX IN BEAM WALKING OF DIFFERENT WIDTHS

SMAJLA, D., MISOTIC, N., STROJNIK, V., TOMAZIN, K.

UNIVERSITY OF LJUBLJANA

Introduction

In balance training, there are no scientific based guidelines concerning the proper load of these exercises. The purpose of this study was to determine the differences between three difficulties of the same balance task, their influence on H-reflex amplitude and to find out if there is a relationship in modulation of H-reflex amplitude and proficiency of balance task.

Methods

The research included 10 participants. Each performed walking over of three different beam widths in random order. Participants walked across one beam per day. Participants performed six walking trials across the same width with their arms crossed over their chest. Soleus H-reflex, corresponding background EMG and walking distance were measured.

Arithmetic mean and standard deviation were calculated. Differences between dependent variables were analysed with repeated measures ANOVA procedure. In case of statistical significance, Tuckey – Post-hoc test was used. In case of abnormal distribution, Friedman test was used (in case of sig. Wilcoxon rank sum test). Pearson and Spearman correlation coefficients were calculated to analyse relationship between chosen variables.

Results

Walking distances was statistically different between three different beam width ($p<0,001$). There was no correlation between background EMG of soleus muscle (bEMG) and H-reflex modulation. Although modulation of H-reflex from soleus muscle was not observed following walking across all beam widths, H-reflex amplitude was significantly lower following narrow beam compared to wide beam ($p<0,001$). Analysis of correlation showed that participants, whose H-reflex amplitude reduction was greater from prone to closed-legged standing, walked greater distance on narrow beam ($p=0,038$). There is also a tendency that participants that walked a greater distance across narrow beam, showed a greater decrease in H-reflex amplitude after walking on narrow beam ($p=0,080$).

Discussion

In conclusion, H-reflex modulation was independent on soleus background EMG and was related with proficiency of walking across narrow beam. Therefore, we suggest that the down regulation of H-reflex can serve as a measure for establishing optimal load during dynamic balance exercise.

Contact

darjan.smajla@fsp.uni-lj.si

EXPLOSIVE VS. CLASSIC STRENGTH TRAINING INDUCE TASK-SPECIFIC NEURAL PLASTICITY

GIBOIN, L., WEISS, B., THOMAS, F., GRUBER, M.
UNIVERSITÄT KONSTANZ

Introduction
Increases in performance after prolonged training interventions follow the specificity principle: You get better at what you train. In this regard, it has recently been demonstrated that after 36 training sessions, explosive strength training enhanced rate of force development (RFD) more than isometric maximal voluntary force (MVC) and classic strength training with sustained contraction increased MVC but had only minor effects on RFD [1]. So far this principle had been tested only for longer training durations with adaptations occurring at the neural as well as the muscular level which both could explain the observed modality specific improvements. In the present study we hypothesized to find training specific neuroplasticity that precedes behavioral adaptations without changes on the muscular level already after a few training sessions.
Methods
Nineteen young healthy male subjects participated in 4 training sessions of either explosive (EXPL group, n = 9) or sustained (SUS group, n = 10) isometric contractions of the knee extensors. We measured, pre- and post-training, MVC, EMG of the vastus lateralis (VL), RFD, voluntary activation (VA) with femoral nerve stimulation and potentiated twitch at rest (Ptw). H-reflex and motor evoked potentials (MEPs) were also measured in the VL during both trained as well as untrained contractions. We triggered stimulations at VL EMG onset to ensure identical pre- and post-training measurement conditions to avoid any interference of the electrophysiological measurements with changes in movement behaviour [2].
Results
Both groups showed increases in MVC and VA, but not Ptw, suggesting that changes at the neural and not at the muscular level improved strength. H-reflexes remained unchanged, but MEP areas decreased only in the trained task, indicating task-specific neural plasticity.
Discussion
In the present study we demonstrated that, already after only four training sessions, two distinct strength training modalities induced specific neural adaptations. The fact that at that time no specific adaptations in performance could be observed suggests that specific neural adaptations may precede specific behavioural adaptations and explain, at least partly, the task-specific improvements in performance that have been reported after prolonged strength training [1].
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A COMPARATIVE STUDY ON THE EFFECTS OF DIFFERENT TYPES OF HIGH-INTENSITY ISOTONIC LEG-EXTENSION TRAINING AT DIFFERENT VELOCITIES ON QUADRICEPS MUSCLE VOLUME

UNLÜ, G., MELEKOĞLU, T., CEVIKOL, C.
MIDDLE EAST TECHNICAL UNIVERSITY,

Introduction
The aim of this study was to investigate the effect of maximal eccentric, maximal concentric and maximal combined concentric-eccentric leg extension training at two velocities [fast, 1800s-1 (3.14 rad s-1) and slow, 300 s-1 (0.52 rad s-1)] on quadriceps muscle volume(QMV).
Methods
Fourty-one untrained (age 18–24) male subjects volunteered to participate in this study as experimental groups; [(slow concentric group (SC; n=7), slow eccentric group(SE; n=7), fast concentric group(FC; n=7), fast eccentric group (FE; n=6), concentric-eccentric group (CE; n=7)] and control group (CN; n=7). Participants were tested before and after 12 weeks of training period for QMV by a 1.5 Tesla moveable magnetic resonance imaging system (MRG) scanner (Siemens Avanto, Erlangen, GERMANY). All experimental groups performed high-intensity leg extension exercise training [80-115 % of one repetition maximum(1-RM); 4 sets of 8-10 repetitons for fast training groups, 50-85 % of 1-RM; 4 sets of 6-8 repetitons for slow training groups (until they reached the level of exhaustion to 8-10 reps)] for 3 days per week. In addition to the 1RM leg extension test, a Cybex isokinetic dynamometer (NORM 6000 CSMI, USA) was used to measure the strength in quadriceps muscle. QMV was measured as the sum of the cross-sectional areas with Osirix ™ DICOM software program (version 2.2.1; Osirix Foundation, Geneva, Switzerland).
Results
Overall, the all experimental groups resulted in significantly greater increases than CN ($p<0.05$) in QMV. While there were significant pretest-posttest increases for SE (209 cm3 , %10,06; $p<0,05$), FC(167 cm3 %7,99 ($p<0,05$), CE (153 cm3 % 6,81; $p<0,05$), SC group (133 cm3 %6,14; $p<0,05$) and non-significant increases for FE (94 cm3 4,42%; $p>0,05$) and CN (74 cm3 %3,76, $p>0,05$). There were significant isokinetic strength increases at 600sn-1 and 1800 sn-1 velocities for all experimental groups ($p<0.05$) but no significant QMV or strength changes occurred in the CN.
Discussion
As a conclusion, the selected isotonic leg-extension trainings were found to be significantly effective for quadriceps muscle volume and strength gain . Even though, any significant difference could not be found between groups, slow eccentric trainings seem to be the most effective type of training for developing muscle volume (10,06 %).

Oral presentations

OP-BN19 Muscle damage and foam rolling

THE EFFECT OF PRECONDITIONING WITH ULTRASOUND DIATHERMY ON MUSCLE DAMAGE

JHUANG, Y.
UNIVERSITY OF TAIPEI

Introduction
Eccentric contraction is easy to induce muscle damage than concentric contraction, because eccentric contraction recruits the fewer muscle fibers, but produce more power, it increases muscle fiber's loading. Passive warm-up can avoid muscle re'injury on weakness, injured or major muscles, and also can improve muscles` temperature as active warm up. Perhaps intervention ultrasound diathermy before exercise is a way to consider. The study was determine the effects of preconditioning with ultrasound diathermy on recovery of muscle damage and muscle function.
Methods
This study was a cross-over design with allocation to two different interventions in random order. Twelve subjects in this study, who randomly assigned to the control group (CON) and ultrasound group (USD), and conduct test on non-dominant hand. Each subject processed 10 reps of 6 sets with maximal eccentric contraction, CON group did not receive any pretreatment before the eccentric exercise, and USD group received 7 minutes of ultrasound hyperthermia intervention on biceps belly. Maximal voluntary isometric contraction (MVIC) was measured before and immediately, day2(D2), day4(D4), day7(D7), day10(D10) after exercise. Serum creatine kinase (CK) was measured before and day2(D2), day4(D4), day7(D7), day10(D10) after exercise.
Results
In MVIC. No significant difference was observed between the baseline and postintervention in either group ($p > .05$). In CK. Significant difference ($p < .05$) was observed between the baseline and D2, D4, D7, D10 of the CON (pre: 165.50 ± 98.84, D2: 257.18 ± 123.49, D4: 676.50 ± 647.82, D7: 1057.27 ± 908.23, D10: 360.73 ± 333.55). No significant difference was observed between the baseline and postintervention of USD. Significant difference ($p < .05$) was observed between the D4 (676.50 ± 647.82 vs. 262.08 ± 196.60), D7 (1057.27 ± 908.23 vs. 168.00 ± 79.35), D10 (360.73 ± 333.55 vs. 149.36 ± 82.01) in the CON and USD.
Discussion
After eccentric exercise will induce muscle damage, no better ultrasound diathermy had been intervention or not. Ultrasound diathermy is contributed to reduce muscle damage, but it cannot replace active warm-up. If we can combine passive warm-up with active warm-up, it is the best way to reduce muscle damage and recovery muscle function faster.

EFFECTS OF FOAM ROLLING ON MUSCLE ARCHITECTURE, EMG-ACTIVITY AND SUBMAXIMAL ISOMETRIC STRENGTH

DOEWELING, A., GABLER, N., FERRAUTI, A.
RUHR-UNIVERSITY BOCHUM

Introduction
Foam-rolling (FR) and roller massage (RM) have become a common practice with warm-up or recovery from exercise. It is believed to promote soft-tissue extensibility, improve muscle function, and enhances blood flow. However, it is not known if RM directly alters muscle properties. Therefore, the aim of this study was to determine if RM has an immediate effect on muscular architecture and EMG-activity during an isometric endurance strength testing protocol.
Methods
In a randomized repeated-measures design (n = 14) the acute effects of a RM intervention on pennation angle and fascicle length of the vastus lateralis as well as EMG-activity of the vastus lateralis, vastus medialis, rectus femoris and biceps femoris during a sustained submaximal isometric knee extension at 60% MVIC until failure were investigated. Each participant completed two allocated tests (FR-Intervention/Control) which were separated by at least 48 hours. The RM-Intervention consisted of 3 x 90s bouts of rolling massage of the quadriceps femoris (7/10 numeric pain scale).
Results
A two-way repeated measures ANOVA revealed no statistically significant main effects or interactions (roller massage intervention x testing) regarding EMG-Activity, pennation angle, fascicle length or submaximal-isometric-test performance.
Discussion
This data suggests that a single bout of RM had no effect on EMG-activity or muscle architectural properties. Furthermore, submaximal isometric performance testing remained unaffected by RM. Based on the present research; RM may not predominately affect muscle architecture nor alter neuromuscular properties.

Oral presentations

OP-PM66 Vascular physiology and health

HABITUAL EXERCISE DECREASES SYSTOLIC BLOOD PRESSURE DURING LOW-INTENSITY RESISTANCE EXERCISE IN HEALTHY MIDDLE-AGED AND OLDER INDIVIDUALS

OTSUKI, T., KOTATO, T., ZEMPO-MIYAKI, A.
RYUTSU KEIZAI UNIVERSITY

Introduction
Since aerobic exercise (e.g., walking) and resistance exercise (e.g., lifting objects and mopping) are both parts of the activities of daily living, an exaggerated elevation in systolic blood pressure (SBP) during aerobic and resistance exercise is an early marker of cardiovascular disease. This study investigated the effects of habitual exercise on SBP during low-intensity resistance exercise using both cross-sectional and interventional approaches.

Methods
N/A
Results
First, in 57 normotensive women (61.9±1.0 years of age) daily physical activity level as assessed by triaxial accelerometry was correlated with SBP during resistance exercise at 20% and 40% of the one-repetition maximum (r=−0.408 and r=−0.348, respectively). Maximal oxygen uptake was correlated with SBP during exercise at 20% (r=−0.385) and 40% (r=−0.457). Physical activity level or maximal oxygen uptake was identified as a predictor of SBP during the exercise in stepwise regression analysis, independent of SBP at rest and other factors (R2=0.729 to 0.781). Second, 66 men and women (64.6±0.9 years of age) participated in a 6-week intervention as a part of the training (walking, 4.3±0.3 d/wk, 55.6±4.1 min/d, 70.7±1.2% of maximal heart rate) or control group. SBP during resistance exercise in the training group decreased after the intervention (before vs. after: 20%, 143±4 vs. 128±4 mmHg; and 40%, 148±5 vs. 134±4 mmHg). In the control group, there were no significant differences in SBP before and after the intervention. SBP during resistance exercise after the intervention was lower in the training group relative to the control group.
Discussion
These results suggest that habitual exercise decreases SBP during low-intensity resistance exercise.

EFFECT OF CONTRACTION INTENSITY ON LEG VASCULAR CONDUCTANCE KINETICS DURING PLANTAR FLEXION EXERCISE IN YOUNGER AND OLDER ADULTS

ASKEW, C.D., DRUCE, P., MENESES, A., RUSSELL, F.D.
UNIVERSITY OF THE SUNSHINE COAST

Introduction
We previously demonstrated that the increase in leg blood flow during plantar flexion exercise at a given absolute contraction intensity does not differ with age, although the kinetics of this increase are slower in older adults. During exercise at a matched relative intensity, the increase in leg blood flow during exercise is generally attenuated in older adults. However, the extent to which ageing influences blood flow kinetics during exercise, and whether exercise intensity modulates any age-effect, is unclear. Therefore, the aim of this study was to compare the kinetic parameters of the leg blood flow and vascular conductance response, between younger and older adults, during plantar flexion exercise at different relative intensities.
Methods
This study included healthy younger (Y: age 20-30 y, n=11) and older (O: age 60-74 y, n=11) adults. Participants completed 3 x 5 min bouts of intermittent isometric plantar flexion exercise, separated by 15 min, at a contraction intensity of 20%, 40%, or 60% of maximum voluntary contraction force, in a random order. Each bout included 60 x 2s contractions. Leg blood flow was measured at baseline, and in 3s rest periods following each contraction, using venous occlusion plethysmography. Mean arterial blood pressure (MAP) was measured at the finger, and leg vascular conductance was calculated as blood flow / MAP. Blood flow and conductance data for each trial were fitted to a 2-phase exponential model to determine the kinetic parameters of the exercise response.
Results
There were no differences between age groups for resting leg blood flow or vascular conductance. MAP was higher in older (98±10) compared with younger participants (80±6 mmHg) at rest, and throughout exercise. Leg vascular conductance increased in an intensity-dependent fashion in both age groups (P<0.001). Maximum conductance during exercise was greater in young (20%: O 0.16±0.018, Y 0.25±0.018; 40%: O 0.28±0.018, Y 0.41±0.019; 60%: O 0.36±0.020, Y 0.53±0.018 ml.100 ml-1.min-1.mmHg-1, P=.006). The young demonstrated a larger amplitude of the initial first phase of the response (P=0.005), and a tendency for a larger amplitude of the second phase (p=0.08, NS). There was also a tendency for a faster rate of rise (P=0.066, NS) during the first phase in the young. There were no significant age x intensity interactions for the leg vascular conductance or blood flow.
Discussion
The increase in leg vascular conductance during plantar flexion exercise is attenuated in older adults, and the rate of rise during the initial phase of exercise tends to be slower than in younger adults. These age-effects are consistently observed across different relative exercise intensities.
Contact
caskew@usc.edu.au

ACUTE BIOMARKER RESPONSES TO EXERCISE IN PEOPLE WITH AND WITHOUT ABDOMINAL AORTIC ANEURYSM

WINDSOR, M.1, BAILEY, T.G.1, PERISSIOU, M.1, GREAVES, K.3, JHA, P.3, MAGEE, R.3, RUSSELL, F.1, GOLLEDGE, J.2, ASKEW, C.D.1
1. VASOACTIVE RESEARCH GROUP, UNIVERSITY OF THE SUNSHINE COAST; 2. JAMES COOK UNIVERSITY AND THE TOWNSVILLE HOSPITAL; 3. SUNSHINE COAST HOSPITAL AND HEALTH SERVICE.

Introduction
Abdominal aortic aneurysm (AAA) is an inflammatory disease characterised by extracellular matrix degeneration and aortic expansion. Human tissue and rodent studies have suggested that tumour growth factor (TGF-β1) prevents AAA by suppressing the production of matrix degrading enzymes, such as matrix metalloproteinase (MMP-9), and production of pro-inflammatory cytokines [1]. In healthy individuals exercise stimulates transient increases in TGF-β1 and decreases in MMP-9 concentrations. The biomarker response to exercise is not known in AAA patients. We assessed the biomarker responses in AAA patients and healthy controls undergoing acute high- and moderate-intensity exercise.
Methods
AAA patients (n=20; age: 74±6 years; BMI: 27±3 kg·m2) and healthy males (n=20; age: 72 ±5 years; BMI: 26±4 kg·m2) completed a cycling test for peak power output (PPO) followed by three experimental protocols in a randomised order: 1. Moderate-intensity continuous cycling at 40% PPO, 2. High-intensity interval cycling at 70% PPO, and 3. Seated rest. Blood samples were taken at baseline and at 0-, 20-, and 90-min after each protocol and were assessed for MMP-9, TGF-β1, interleukin (IL)-6, IL-10 and tumour necrosis factor (TNF). Data were analysed with a three-way linear mixed model [mean (95% confidence intervals)].
Results
Baseline TNF was 32.6 pg/ml (7.4, 57.8; p=0.012) higher in AAA patients than in healthy controls, with no other baseline biomarker differences between groups. All biomarkers were unchanged after seated rest and no differences in responses were observed between

moderate and high-intensity protocols (p>0.05). Immediately after exercise, TGF-β1 concentrations increased by 2 ng/ml (0.6, 3.4; p=0.006) in both AAA patients and healthy controls. MMP-9 concentrations in healthy controls increased by 136 ng/ml (36, 236; p=0.008) immediately post-exercise but were unchanged in AAA patients. 90 minutes after exercise MMP-9 concentrations in AAA patients decreased by 218 ng/ml (118, 318; p≤0.001), with no change in healthy controls. No exercise-induced changes were observed for IL-6, IL-10 or TNF in AAA or healthy.
Discussion
Exercise-induced increases in TGF-β1 appear to be associated with different changes in MMP-9 concentrations in AAA patients and healthy controls. It is possible that exercise could represent a means to positively promote more effective arterial remodelling in AAA patients.
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Contact
mark.windsor@research.usc.edu.au

EFFECT OF EXERCISE INTENSITY ON THE ACUTE RESPONSE OF ARTERIAL STIFFNESS IN PEOPLE WITH AND WITHOUT ABDOMINAL AORTIC ANEURYSM

PERISSIOU, M.1, BAILEY, T.G.1, WINDSOR, M.1, NAM, M.2, GREAVES, K.2, SCHULZE, K.3, LEICHT, A.4, GOLLEDGE, J.4, ASKEW, C.D.1

1VASOACTIVE RESEARCH GROUP, UNIVERSITY OF THE SUNSHINE COAST, QLD, AUSTRALIA 2SUNSHINE COAST HOSPITAL AND HEALTH SERVICE 3 SUNSHINE VASCULAR CLINIC 4JAMES COOK UNIVERSITY.

Introduction
Abdominal aortic aneurysm (AAA) is characterised by an abnormal dilation of the aorta, with AAA growth and rupture related to elevated arterial stiffness. Acute exercise leads to a reduction in arterial stiffness in healthy adults (1), which may be augmented with higher exercise intensity and linked to lower basal arterial stiffness seen with training. We aimed to assess the effect of exercise intensity on the acute response of arterial stiffness in AAA patients compared to healthy adults.
Methods
Patients with AAA (n=22; 74±6 y; BMI 28±4 kg·m2) and healthy adults (n=22; 72±5y; BMI 26±4 kg·m2) underwent a cycling test for peak power output (PPO) and cardiorespiratory fitness (VO2peak) followed by three experimental visits in a randomised order: protocol 1) moderate-intensity exercise at 40% PPO (MIE); 2) high-intensity interval exercise at 70% PPO (HIE); or 3) no-exercise control (NoEx). Pulse wave velocity (PWV), reflection magnitude (RM) and heart-rate corrected augmentation index (AIx75) were assessed at rest and for 90 min following each protocol using SphygmoCor Xcel.
Results
VO2peak was higher in healthy adults compared to AAA [mean diff 5.5 ml.kg-1.min-1 (95%CI 3.4 to 7.3, p<0.001)]. Resting PWV was 2.27 m·s-1 (1.5 to 3.1, p<0.001) higher in AAA compared to healthy adults, with negligible differences for AIx75 [mean diff 2.8% (-0.4 to 6, p=0.91)] and RM [mean diff 3.0% (-1.7 to 7.8, p=0.207)]. After NoEx, PWV increased by 1.3 m·s-1 (0.9 to 1.7, p<0.001), with no group effect. We found no differences in exercise induced arterial stiffness responses between AAA and healthy adults. PWV decreased following HIE and MIE, and was 0.2 m·s-1 (0.06 to 0.4, p=0.005) and 0.83 m·s-1 (0.7 to 1, p<0.001) lower after HIE compared to MIE and NoEx, respectively. RM did not change after NoEx, but decreased by 14.4% (10 to 18, p<0.001) after MIE and 18.5% (15 to 22, p<0.001) after HIE. After HIE, RM was 1.8% (0.2 to 3.4, p=0.030) lower compared to MIE. AIx75 decreased after each protocol, the largest decrease was seen after NoEx, which was 1.8% and 2.1% lower than after HIE and MIE, respectively (p<0.001).
Discussion
Acute exercise transiently offsets increases in PWV and RM after NoEx in both AAA and healthy adults, with larger improvements in PWV and RM after HIE compared to MIE. Exercise had no effect on AIx75 compared to NoEx. These exercise induced reductions in AAA arterial stiffness suggest that exercise training may lead to lower basal arterial stiffness in patients with AAA.
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Contact
maria.perissiou@research.usc.edu.au

THE ACUTE EFFECTS OF EXERCISE INTENSITY ON BRACHIAL ARTERY ENDOTHELIAL FUNCTION IN ABDOMINAL AORTIC ANEURYSM PATIENTS

BAILEY, T.G., PERISSIOU, M., WINDSOR, M., RUSSELL, F., NAM, M., GREAVES, K., GREEN, D.J., GOLLEDGE, J., ASKEW, C.D.

1UNIVERSITY OF THE SUNSHINE COAST 2SUNSHINE COAST HOSPITAL AND HEALTH SERVICE 3UNIVERSITY OF WESTERN AUSTRALIA 4TOWNSVILLE HOSPITAL AND JAMES COOK UNIVERSITY

Introduction
Endothelial function is reduced in patients with Abdominal Aortic Aneurysm (AAA) and worsens with increasing AAA size. Further, AAA patients exhibit high cardiovascular disease prevalence and mortality rates unrelated to AAA (1). Improving endothelial function with exercise may slow AAA growth and improve morbidity and mortality. Recently, we found increased flow-mediated dilation (FMD) responses after acute exercise are dependent on exercise intensity and cardiorespiratory fitness in elderly males. We aimed to determine if the FMD responses to acute moderate- and high-intensity exercise would be similar in AAA compared to healthy, elderly adults.
Methods
AAA patients (n=22; 74±6 y; BMI 28±4 kg·m2) and healthy males (n=22; 72±5y; BMI 26±4 kg·m2) undertook three visits, seven days apart in a randomised order; 27 min moderate-intensity continuous cycling exercise (MICE; 40% Peak Power Output, PPO), high-intensity interval cycling exercise (HIIE; 70% PPO), and no-exercise control (NoEx). Brachial artery FMD was assessed at rest, then 10 and 60 min post. Data were analysed with a three-way linear mixed model [mean (95%CI)] and relationships were assessed using Pearson's coefficient.
Results
VO2peak and basal FMD were 5.5 ml·kg-1·min-1 (3.4 to 7.3, p<0.001) and 1.10% (0.72 to 1.81; p=0.044) lower, respectively, in AAA compared to healthy adults. We found a positive relationship between VO2peak and FMD in AAA (r=0.502, p=0.017), but not in healthy adults

(r=0.078, p=0.729). There were no differences in the FMD responses observed after each protocol between AAA and healthy adults (p=0.397). From baseline, FMD decreased by 0.43% (-0.96 to 1.10, p=0.115) 60 min following NoEx in both groups. FMD increased by 1.21% (0.69 to 1.73), p<0.001) 10 min after MICE in both groups, and normalised after 60 min (mean difference 0.16 % (-0.04 to 0.69, p=0.540). Conversely, FMD decreased by 0.93% (0.41 to 1.44, p<0.001) after HIIE, and remained decreased after 60 min by 0.51% (0.01 to 1.02, p=0.050) in both groups.
Discussion
This study shows changes in FMD with acute exercise are similarly altered by exercise intensity in AAA compared to elderly adults. MICE increases FMD before returning to pre-exercise levels, whilst sustained decreases in FMD following HIIE in both groups may represent signalling for future vascular adaptation. As observed in elderly adults, HIIE training induced increases in VO2peak and endothelial function may reduce cardiovascular risk in patients with AAA, and potentially slow AAA growth.
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Contact
tbailey@usc.edu.au

RELATIONSHIPS BETWEEN CENTRAL AND LOCAL ARTERIAL STIFFNESS IN OLDER ADULTS

SHKREDOVA, D., D'ISABELLA, N.T., FANG, H., MACDONALD, M.J., HEISZ, J.J., TANG, A.
RADBOUD UNIVERSITY MEDICAL CENTER

Introduction
Arterial stiffness is an established marker of atherosclerotic progression and an independent predictor of cardiovascular risk. The criterion standard for assessing systemic arterial stiffness is carotid-femoral pulse wave velocity (cfPWV), where a higher cfPWV value is reflective of greater stiffness. Due to differences in wall composition throughout the arterial tree, there may be differences in stiffness of central versus more localized arterial segments such as the common carotid artery (CCA). Stiffness of the CCA can be evaluated using compliance and distensibility, where greater values reflect lesser stiffness. Examining associations between systemic and localized arterial stiffness may provide insight on differences in vascular disease progression throughout the arterial tree. Therefore, the purpose of this study was to investigate associations between cfPWV and compliance and distensibility of the CCA.
Methods
Community-dwelling older adults without known cardiovascular conditions were recruited for this cross-sectional study. Arterial stiffness was assessed using cfPWV (measured using applanation tonometry), as well as compliance and distensibility of the CCA (measured using ultrasonography). Pearson correlation analyses were used to examine the relationships between these measures.
Results
In 33 participants (mean±SD age 70.8±4.3 years, 47% male), cfPWV was 10.1±2.1 m/s, compliance was 0.100±0.035 mm^2/mmHg and distensibility was 0.003±0.001 mmHg^-1. There was no relationship between cfPWV and CCA distensibility (R=0.197, p=0.281), however cfPWV and CCA compliance were positively correlated (R=0.502, p=0.003).
Discussion
The differences in the associations between cfPWV and CCA distensibility and compliance may indicate regional differences in vascular disease progression that are sensitive to the index being used to examine vascular properties. Further research is needed to examine the underlying mechanisms behind these findings and to corroborate them in a larger sample.

Oral presentations

OP-PM67 Injury prevalence and prevention in team sports

THE COMPARISON OF <11+> AND WARM-UP PROGRAMS ON INJURY PREVENTION, AGILITY AND SPEED DRIBBLING IN YOUNG MALE SOCCER PLAYERS

ASGARI, S.M., ALIZADEH, M.H., SHAHRBANIAN, S.H.
1-2TEHRAN UNIVERCITY 3-BOU ALI SINA UNIVERSITY

Introduction
The FIFA Medical and Research Center(F-MARC)has designed a comprehensive warm-up program(+11)to decrease injury risk for soccer players(Soligard, Myklebust et al. 2008); however, the results of previous studies have found several deficits such as no significant reduction of ankle injury rate in this program.(Al Attar, Soomro et al. 2015). Also,there is limited information about the effectiveness of this program on the performance of soccer player's(Rahnama 2012). This has reduced the tendency of using this program among coaches and soccer players (Soligard, Nilstad et al. 2010)
The aim of this study was to compare the effects of(11+) and(modified 11+) warm up programs on injury prevention, agility and speed dribbling among young male soccer players.
Methods
Two teams in youth Iranian soccer tournament were randomly assigned into the experimental(n=31)and the control(n=29) groups and observed during the season. The experimental group used the(modified 11+) and control group used the(11+)warm-up program for loosen up before training and competition. The total injury rate during the research were recorded. To investigate the agility of players, Illinois Agility Test and to investigate players Dribbling speed, Slalom Dribbling Test were used. Data were analyzed using analysis of variance and SPSS software version 22.
Results
Soccer players in the experimental group were significantly less injured than the control group(p <0/05). There was significant difference in the pre-test vs. post-test, between experimental(14.15± 1.14 vs. 13.11± 1.11)and control(14.18 ± 1.29 vs. 13.64 ± 1.29) group in the Dribbling speed test. There was also significant difference, in the pre-test vs. post-test, between experimental (17.30 ± 0.66 vs. 16.21 ± 0.61) and control (17.23 ± 0.55 vs. 16.70 ± 0.77) group in the Illinois test.
Discussion

the results of present study showed that(modified 11+) compared to(11+), significantly reduced the rated of injuries and increased the performance of young male soccer players. It seems that modifying the comprehensive warming up program by balance, dynamic, stretching, agility and plyometric exercises, improve the performance of the subjects and decreased the injuries rate rather than ordinary (11+). So it is recommended to use (modified 11+) warm-up program before training and competition.

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Contact

masgarisocer@gmail.com

CORE STABILITY RELATED FMS ITEMS AS MAIN PREDICTORS OF INJURY RISK IN AMATEUR MALE SOCCER PLAYERS

KOLODZIEJ, M., BREER, M., JAITNER, T.

TU DORTMUND

Introduction

Playing soccer on an amateur level bears a particular high risk of injury because the players often lack on an adaequate level of overall physical fitness, which is considered as an intrinsic risk factor for injury occurrence. The Functional Movement Screen (FMS) has been applied successfully to identify predisposed players and their injury risk mainly in professional sports (Kiesel et al., 2007). Less empirical evidence on the FMS in amateur soccer is given. Further, the FMS composite score contains upper and lower body as well as core related items, which might be related differently on soccer-specific injury incidences. The aim of this study was therefore twofold: First, to investigate the relationship between FMS score and injury occurrence in amateur soccer players and, secondly, to analyze the contribution of single test items on the injury state.

Methods

83 male soccer players (23 ± 4 years old, Germany's fifth, sixth and seventh division) passed the FMS prior to the preparation period of the season 2015/16. Injuries were continuously documented throughout the first competition period by a questionnaire following Kiesel et al. (2007). FMS scores as well as injury incidence were determined and analyzed using the Mann-Whitney U-test ($p < 0.05$), Receiver Operating Characteristic (ROC) and Pearson's chi-squared test.

Results

The overall injury incidence was 6.9 injuries per 1000 hours playing time. FMS score differed significantly ($p= 0.017$) between injured (15.1 ± 2.5) and non-injured (16.5 ± 2) players. The cut-off-score of 14 represented a sensitivity of 0.45 and specificity of 0.88 and was associated with injury (risk ratio: 2.03). Significant correlations between single test items with a score ≤ 2 and injured players were found for the trunk stability pushup exercise ($x^2= 0.028$) as well as for the rotary stability exercise ($x^2= 0.031$).

Discussion

A 2-fold increase in risk of injury has been shown for a FMS score of 14 or less. In addition to Kiesel et al. (2007), the FMS score therefore seems to be an eligible indicator for injury risk in amateur soccer. Core related test items were mainly related to injury outcome. Hence, injured players had lower core stability as well as lower core strength. This finding highlights the relevance of core stability and core strength for the prevention of lower extremity injuries in amateur male soccer players. For deeper insight in the prediction of injuries in soccer more prospective studies are needed that consider the multifactorial injury risk factors.

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HEAD COACHES' RETURN TO PLAY DECISION MAKING AFTER INJURIES IN TEAM SPORT ATHLETES: UPON WHO OR WHAT THEY RELY ON?

NIEDERER, D., WILKE, J., VOGT, L., BANZER, W.

GOETHE UNIVERSITY FRANKFURT/MAIN

Introduction

As head coaches of semi-professional sport teams are most often in charge of the final return to play (RTP) decision, it is of importance to assess how different decision-guiding factors, such as health and performance related actuators, as well as evidence based guidelines, support their process-orientated RTP decision.

Methods

A survey consisting of questions on the importance of different decision-guiding factors used when making the RTP decision following injuries was administered to head coaches of semi-professional players' teams (football, volleyball, handball, ice hockey, field hockey, basketball, rugby, baseball). With respect to helpfulness in the RTP decision-making process, the coaches rated both the importance of the opinion of physicians, physiotherapists, strength and condition coaches, the athletes, themselves, and of both general and injury-specific RTP guidelines.

Results

238 questionnaires were included into analysis. Our survey revealed that the head coaches refer to physicians and physiotherapists to a large extent, to the athletes and to themselves to a medium extent, and to strength and conditioning coaches and RTP guidelines to a small but still relevant extent. The coaches' effort to seek a shared decision-making process in RTP is, hence, partially evident.

Discussion

A multitude of actuators intervenes when making the RTP decision (Ardern et al., 2016). The call for a professionalization of the RTP process in semi-professional sports includes the athlete itself, the head coach, the (external) physician, the (external) physiotherapists and the strength and conditioning coach based on general RTP decision-making models and specific criteria related to injury type, sports type, level and playing position (Shrier et al., 2014). The development of awareness and implementation strategies of RTP models should be subject to further research.

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Contact
daniel.niederer@em.uni-frrankfurt.de

IS THE MESSAGE GETTING THROUGH? AWARENESS AND USE OF THE FIFA11+ WARM-UP PROGRAM IN AMATEUR LEVEL FOOTBALL CLUBS

WILKE, J., NIEDERER, D., VOGT, L., BANZER, W.

GOETHE UNIVERSITY FRANKFURT

Introduction
A large body of evidence suggests that the FIFA 11+ program is effective in preventing musculoskeletal injuries in football players. However, despite considerable efforts to promote and disseminate the intervention, it is unclear whether coaches are familiar with the 11+ and how they rate its feasibility. The present study therefore aimed to gather information on awareness and usage of the FIFA11+ among German amateur level football coaches.
Methods
A questionnaire was administered to 7893 coaches who were in charge of youth and adult non-professional football teams (all leagues except the best four). Descriptive and inference statistics (α=.05) were used to analyze the obtained data.
Results
A total of 1223 coaches (16%) returned the questionnaire. There was no risk of a non-response bias ($p>.05$). At the time of the survey, nearly half of the participants (43.6%) knew the FIFA11+. Among the coaches who were familiar with the program, three of four reported applying it regularly. Holding a license, high competitive level, and coaching a youth team were associated with usage of 11+ ($p<.05$) while non-awareness was negatively correlated to license ownership ($p<.05$). Feasibility and suitability of the 11+ were not rated differently by aware and unaware coaches ($p>.05$).
Discussion
Although a substantial share of German amateur level coaches is familiar with the FIFA11+, more than half of the surveyed participants did not know the program. As non-use does not appear to stem from a lack of rated feasibility and suitability, existing communication strategies might need to be revised.
Contact
wilke@sport.uni-frankfurt.de

AN AGE-SPECIFIC WARM-UP PROGRAMME TO PREVENT INJURIES IN CHILDREN'S FOOTBALL REDUCES HEALTH CARE COSTS: AN ECONOMIC IMPACT STUDY

RÖSSLER, R.1, VERHAGEN, E.2, DVORAK, J.3, JUNGE, A.3,4, LICHTENSTEIN, E.1, DONATH, L.1, FAUDE, O.1

1UNIVERSITY OF BASEL, BASEL, SWITZERLAND 2VU UNIVERSITY AMSTERDAM, THE NETHERLANDS 3SCHULTHESS KLINIK AND SWISS CONCUSSION CENTRE, ZURICH, SWITZERLAND 4MEDICAL SCHOOL HAMBURG, GERMANY

Introduction
The burden of sport injuries in children involves medical, human, and financial resources at many levels (Caine et al. 2006; Collard et al. 2011). An age-specific injury prevention programme ("FIFA 11+ Kids") has shown to reduce injuries in children's football (Rössler et al. 2016). The objective of the present study was to evaluate potential reductions of health care costs of "FIFA 11+ Kids" compared to a standard warm-up in children's football.
Methods
Healthcare resource use (e.g. number of visits to healthcare professionals, specific treatments, etc.) was collected prospectively alongside a cluster randomised controlled trial over one football season (2014/2015) in Switzerland. Study participants were girls and boys aged 7 to 12 years. The intervention group conducted "FIFA 11+ Kids" (replacing the usual warm-up) at the beginning of each training session throughout the season. Participants in the control group performed their standard warm-up routine.
Standardized medical fees according to the national medical association ("Tarmed") enabled a precise estimation of the direct medical costs. All costs are reported in Swiss Francs (CHF). Descriptive statistics were used to compare costs between groups (preliminary data analysis).
Results
In total, 1035 players (7% girls) took part in the study and 76374 hours of football exposure were recorded. Mean age of players was 10.9 (SD 1.2) years. During the study period N=99 injuries occurred of which N=53 (intervention group N=20, control group N=33) led to medical consultation. Total costs per injury were CHF 239 (range 72–1480) in the intervention group and CHF 441 (range 74–1686) in the control group. Total costs per 100 player seasons appear to be lower in INT (CHF 1171) compared to CON (CHF 3900).
Discussion
This preliminary analysis suggests that injury prevention in children´s football has the potential to reduce medical costs. From a societal perspective, a broad implementation appears warranted to reduce health care costs.
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Contact
roland.roessler@unibas.ch
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Oral presentations

OP-PM73 Metabolism in different sports

EFFECT OF ACCUMULATED WALKING AND STANDING ON POSTPRANDIAL METABOLISM IN INACTIVE ADOLESCENT GIRLS

TOLFREY, K., BARRETT, L.A., SMALLCOMBE, J.W.
LOUGHBOROUGH UNIVERSITY

Introduction
During adolescence, a precipitous decline is observed in the number of girls meeting age-specific physical activity recommendations. The identification of alternative forms of accessible physical activity, that may confer long-term benefit to the metabolic health of this population, represents an important avenue for research. This study aimed to assess the effect of short, repeated bouts of walking and standing on postprandial metabolism in inactive adolescent girls.
Methods
Seventeen girls (12.8 (0.4) years) completed two, 3-day experimental conditions. On each of days 1 and 2 of the physical activity condition (PA), participants completed 4 × 10 min bouts of self-paced treadmill walking and accumulated 18 x 5 min standing bouts over the course of a simulated school day (07:30 to 15:30). On PA day 3, participants attended school as normal with no additional physical activity prescribed. On all 3 days of the control condition (CON), participants attended school as normal with no specific physical activity prescribed. On days 2 and 3 of both PA and CON, a capillary blood sample was provided to determine fasting [TAG] and [glucose]. Participants then consumed a standardised breakfast (0 h) and lunch (4.7 h) and blood samples were provided postprandially at 2.7, 5.3 and 7.3 h for [TAG] and [glucose].
Results
The mean 10 min, treadmill walking speed of 5.8 (0.3) km•h-1 elicited a heart rate of 143 beats•min-1 and OMNI rating of 2 (easy). Dietary intake and composition 24 h before day 1 was similar between PA and CON (ES≤0.27). Linear mixed model analyses indicated that total areas under the time curves for natural logs of triacylglycerol (TAG) and glucose were not meaningfully different between PA and CON (ES≤0.04) and the changes from day 2 to 3 were consistent between PA and CON (ES=0.10).
Discussion
The combined accumulation of 80 min walking at a self-selected pace and 180 min standing over two consecutive simulated school days in the PA condition was insufficient to reduce postprandial lipaemia or glycaemia in inactive adolescent girls compared with standard school attendance (CON). Higher volumes of light physical activity, or activity of higher relative intensity may be required to induce desirable acute metabolic responses in this population. Further research is, however, warranted to assess the effect of long-term adherence to light physical activity on postprandial metabolic regulation.

EFFECT OF SMALL-SIDED FOOTBALL ON POSTPRANDIAL LIPAEMIA IN ADOLESCENT BOYS: A COMPARISON WITH MODERATE-INTENSITY EXERCISE

SMALLCOMBE, J.
LOUGHBOROUGH UNIVERSITY

Introduction
An acute bout of prior, moderate- to high-intensity exercise attenuates postprandial lipaemia (PPL) in young people (Tolfrey et al., 2014). However, the laboratory-based exercise known to induce this desirable physiological response bears little resemblance to the free living physical activities in which young people typically engage. Therefore, this study was designed to compare the effect of laboratory-based treadmill exercise and free-living afterschool football activity on PPL in adolescent boys.
Methods
Fifteen boys (12.6 (0.5) years) completed three, 2-day experimental conditions. On day 1, participants either: rested (CON); exercised for 48 min on a treadmill at 60% peak VO2 (TM-EX); or played 48 min of 5-a-side football (FBALL). On day 2, participants attended school where a capillary blood sample was provided to determine fasting triacylglycerol concentration ([TAG]). Participants then consumed a standardised breakfast (0 h) and lunch (4.5 h) and blood samples were provided postprandially at 2.5, 5.0 and 7.0 h for [TAG].
Results
During TM-EX a heart rate of 157 (7) beats·min-1 was elicited and a total distance of 5.9 (0.5) km was covered. In contrast, during FBALL a heart rate of 175 (8) was elicited and a total distance of 3.5 (0.4) km was covered. Based on ratios of geometric means, reductions in fasting [TAG] were small-moderate after TM (95% CI = -27 to -2%, ES = 0.46), but large after FBALL (-41 to -18%, ES = 1.00) compared with CON; the concentration was also significantly and moderately lower in FBALL compared with TM (-25 to -5%, ES = 0.53). Compared with CON, the total area under the [TAG] versus time curve (TAUC-TAG) was 18% lower in TM (-29 to -5%, ES = 0.51) and 25% lower in FBALL (-35 to -13%, ES = 0.76). Although TAUC-TAG was 9% lower in FBALL compared with TM, this difference was small and non-significant (-21 to 5%, ES = 0.25).
Discussion
Compared with duration-matched inactivity (CON), both small-sided football (FBALL) and treadmill exercise (TM) reduced postprandial lipaemia in adolescent boys; the effect was larger after playing football than time-matched treadmill exercise.
Reference
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MAXIMAL FAT OXIDATION IS RELATED TO PERFORMANCE IN AN IRONMAN TRIATHLON

FRANDSEN, J., VEST, S.D., LARSEN, S., DELA, F., HELGE, J.W.
UNIVERSITY OF COPENHAGEN

Introduction
It is well known that carbohydrate stores are limited and that exogenous uptake cannot match utilization rates during prolonged moderate to high intensity exercise and this inevitably leads to muscle and liver glycogen depletion and thus fatigue and decreased perfor-

mance, known as "hitting the wall". A number of approaches, high fat feeding, overnight fasted training, training with low glycogen content and recently keto-adaptation have been applied to achieve enhanced endurance performance, but for performance times below 2-3 hours, there is no solid evidence supporting any other procedure than the traditionally recommended high carbohydrate diet in athletes. However, when performance times are above 4 hours there are very few good studies linking performance and metabolism. The aim of the present study was to investigate the relationship between maximal fat oxidation rate (MFO) measured during a progressive exercise test on a cycle ergometer and ultra-endurance performance. We hypothezied that a high maximal fat oxidation capacity measured by an incremental exercise cycle test would translate into a performance benefit and thus a faster racetime in an ironman-distance triathlon.
Methods
Sixty-one male ironman athletes (age: 35±1 yrs [23-47 yrs], with a BMI of 23.6±0.3 kg/m2 [20.0 - 30.1 kg/m2], a body fat percentage of 16.7±0.7% [8.4 - 30.7%] and a VO2peak of 58.7±0.7 ml/min/kg [43.9 - 72.5 ml/min/kg] were tested in the laboratory between 25 and 4 days prior to the ultra-endurance event, 2016 Ironman Copenhagen. Venous blood samples were drawn before each test and indirect calorimetry obtained pulmonary gas exchange measurements throughout the tests.
Results
Simple bivariate analyses revealed significant negative correlations between race time and MFO ($r2= 0.12$, $p<0.005$) and VO2peak ($r2= 0.45$, $p<0.0001$) and a positive correlation between race time and body fat percentage ($r2=0.27$, $p<0.0001$). MFO and VO2peak were not correlated. When the significant variables from the bivariate regression analyses were entered into the multiple regression models, VO2peak and MFO together explained 52% of the variation observed in race time among the 61 Ironman athletes ($R2=0.52$, $p<0.001$).
Discussion
These results suggests that maximal fat oxidation rate exert an independent influence on ultra-endurance performance (>9 hours). Furthermore, we demonstrate that 52 % of the variation in Ironman triathlon race time can be explained by peak oxygen uptake and maximal fat oxidation.
Contact
Jacobf@sund.ku.dk

A GREATER MAXIMAL FAT OXIDATION RATE OCCURS AT A HIGHER EXERCISE INTENSITY DURING EXERCISE IN A COLD ENVIRONMENT

GAGNON, D.D., PERRIER, L., DORMAN, S., LARIVIÈRE, C., SERRESSE, O.

LAURENTIAN UNIVERSITY

Introduction
The ability to oxidize lipids is a core determinant of mitochondrial health. The examination of energy substrate oxidation under thermal stress has previously demonstrated an increase in lipid utilization during walking and running in the cold but not during cycling at fixed intensities 2-3. We are currently unaware if these fundamental metabolic differences differ across the exercise intensity spectrum. The aim of the study was to examine the influence of environmental temperature on energy substrate oxidation in a cold and warm environment across a range of exercise intensities during running and cycling.
Methods
Nine male subjects (21.2 ± 1.4 yrs, 84.0 ±1 4.6 kg, 1.76 ± 0.07 m, 10.6 ± 5.7 %BF, 53.3 ± 6.2 mlO2 • kg-1 • FFM-1•min-1), dressed in shorts and t-shirt, performed four adapted incremental maximal oxygen consumption (VO2max) tests on a cycle ergometer or treadmill in a cold (4.6 ± 2.3 °C) or warm environment (35.6 ± 2.6 °C) designed to include 6 to 15 three-min stages1. Cardio-metabolic variables including VO2, maximal fat oxidation rate (MFO), and exercise intensity where MFO occurs (Fatmax). Skin temperature (Tsk) and lactate were also assessed. Data was analyzed using a two-way ANOVA (factors: temperature, exercise modality) for repeated measures with significance at $p<0.05$.
Results
VO2max in the treadmill condition was 47.2 ± 5.9 mlO2 • kg-1 • min-1 and 39 ± 6.8 mlO2 • kg-1 • min-1 in cycling. Tsk was lower in the cold for both running and cycling conditions (26.4 ± 0.9°C vs. 35.6 ± 0.9°C; $p<0.001$). During running, MFO was greater in the cold vs. warm (0.68 ± 0.3 g•min-1 vs. 0.48 ± 0.23 g•min-1; $p=0.026$) which also occurred at a higher Fatmax (58 ± 20 % vs. 39 ± 17 % of VO2max; $p=0.003$). During cycling, MFO was not significantly different between conditions ($p=0.067$) but Fatmax was greater in the cold vs. warm (62 ± 28 % vs. 36 ± 13 % of VO2max; $p=0.003$). Lactate was greater post exercise ($p<0.001$) with no interaction of neither temperature ($p=0.159$) nor exercise modality ($p=0.843$).
Discussion
The present results demonstrate significant influences of environmental temperature on energy metabolism during running and cycling across the exercise intensity spectrum. We demonstrated that running in a cold environment increases maximal fat oxidation rate which peaked at a higher exercise intensity compared to a warm environment.
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Contact
ddgagnon@laurentian.ca

NEGATIVE VO2 SLOW COMPONENT DURING DOWNHILL RUNNING

LEMIRE, M.1,2, LONSDORFER-WOLF, E.1,3, ISNER-HOROBETI, M.E.1,4, KOUASSI, B.Y.L.2, GENY, B.1,3, FAVRET, F.1,2, DUFOUR, S.P.1,2

UNIVERSITY OF STRASBOURG

Introduction
The oxygen uptake response to constant load exercise depends on the subjects' training status as well as on the intensity and mode of exercise (Poole et al, 2012). During high and constant intensity runs (i.e > ~80% VO2max), a VO2 slow component occurs, with a greater amplitude in uphill (10% slope) vs level running (Pringle et al, 2002). Therefore, the amplitude of the VO2 slow component might be exacerbated in exercise modes favoring concentric rather than eccentric muscle actions (Perrey et al, 2001). Whether downhill running does

induce a VO2 slow component is currently not known. Therefore, the aim of this study was to determine the amplitude of the VO2 slow component during uphill vs downhill running.
Methods
Eight endurance athletes performed a maximal incremental test and two 15min running bouts (uphill (+15%) or downhill (-15%)), at the same absolute running velocity (46% of the velocity associated to VO2max). Oxygen uptake (VO2), heart rate (HR) and ventilation (VE) were continuously recorded and blood lactate was measured before and after each trial. Slow components were established as end-exercise minus third minute exercise value.
Results
By design, running velocity was similar in uphill vs downhill trials (8.5+/-0.4km/h) but end-exercise VO2 (61+/-4 vs 19+/-5 ml/min/kg), ventilation (139+/-24 vs 42+/-7 L/min), blood lactate (9.0+/-5.3 vs 2.2+/-1.8 mmol/L) and HR (172+/-9 vs 120+/-14bpm) were greater in uphill running (all $p<0.05$). Positive slow components were observed in uphill running for VO2 (0.218+/-0.174 L/min), VE (30+/-20 L/min) and HR (18+/-4 bpm). In contrast, inverse and negative slow components occurred for VO2 (-0.242+/-0.259 L/min), VE (-6+/-3 L/min) and HR (-5+/-6 bpm) when running downhill (all $p<0.05$ vs uphill).
Discussion
These results further characterize the cardiorespiratory responses to downhill running and specifically demonstrate an inverse, negative VO2 slow component during downhill running in well-trained endurance runners. A combination of metabolic and mechanical factors is probably involved in the regulation of VO2 during downhill running. Whether a negative VO2 slow component also occurs at higher downhill running velocities remain to be explored.
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A RESEARCH ON CHARACTERISTICS OF ENERGY CONSUMPTION IN BADMINTON ON CHINESE RESIDENTS

ZHANG, Y.
CHINA INSTITUTE OF SPORT SCIENCE

Introduction
This research analyzes the characteristics of energy consumption in badminton of Chinese residents, which could help people improve their fitness level.
Methods
Participants included 112 men and 128 women of age 20-30, and 152 men and 120 women of age 31-40. Weight range: Men: 50kg-90kg; women: 45kg-70kg. The test was conducted in a professional indoor badminton court. The participants play a real game wearing the CORTEX-3B exercise cardiopulmonary function tester and heart rate monitor. The training partners and the participants were equivalently skilled. The average value of energy consumption and the heart rate at the steady performance stage in the process of the game was taken. The test index also includes the height, weight, body composition, resting metabolic rate. Analysis of variance was used. It's statistically significant if $P<0.05$. With simple regression and multiple regressions, the energy consumption regression equation of badminton was established.
Results
The energy consumption level in sports of men was always higher than that of women ($P<0.01$). The weight of the participants was moderately correlated with energy consumption in sports ($R=0.546$ and $P<0.01$). The percentage of body fat of Chinese residents had a low negative correlation with energy consumption in sports ($R=-0.381$ and $P<0.01$). The lean body weight
of Chinese residents, male residents and female residents all had a high correlation with energy consumption in sports. $R=0.864$ and $P<0.01$; $R=0.892$ and $P<0.01$; $R=0.859$ and $P<0.01$, respectively. Through the lean body weight, the equation with one unknown quantity was established, and energy consumption in sports of residents was 0.057FFM+1.96 ($R2=0.739$). Gender, age, weight, BMI, body fat and fat free mass all had a linear relationship with energy consumption in sports. The following equation can be inferred: $Y=4.726+0.309a+0.057b+0.012c-0.004d+0.055e$ (Y is energy consumption in sports, a represents gender, b age, c weight, d body fat, e fat free weight, $R2= 0.792$ and $P<0.01$).
Discussion
The regression equation of energy consumption, which highly correlated to gender, age, weight, body fat and lean body weight, was established.
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Adapted Physical Activity

RELATIONSHIP BETWEEN SELF-REPORTED PHYSICAL ACTIVITY FROM THE HEALTH BEHAVIOUR IN SCHOOL-AGED CHILDREN INSTRUMENT AND OBJECTIVE DAILY STEPS IN CHILDREN

OKAZAKI, K., KOYAMA, Y., OHKAWARA, K.
TOHOKU GAKUIN UNIVERSITY

Introduction
The self-reported physical activity (PA) assessment in the Health Behaviour in School-aged Children (HBSC) study is one of the most widely utilised questionnaires to assess levels of physical activity in children. The present study aimed to evaluate the relationship between PA data obtained via the HBSC instrument and objective daily steps (DS) in Japanese children.
Methods
A total of 184 elementary school children (89 boys, 95 girls) in the fourth grade and higher completed the questionnaire and wore an accelerometer. The PA of the HBSC questionnaire (Booth et al., 2001) was used to collect data regarding the frequency and total amount of time children engaged in vigorous exercise outside school PA class hours. Children who reported that they were vigorously physically active "2–3 times/week", "4–6 times/week", or "every day" for "about 1 hour/week" or more were classified as active. Children who reported their frequency of activity as "once a month or less" or "once a week", and who reported their duration of activity as "none" or "about half an hour/week", were classified as inadequately active. Objective DS were estimated using a triaxial accelerometer.
Results
Mean DS values for children who reported being vigorously physically active every day (10,420 steps) were significantly higher than those of children who reported being active 4-6 times/week (7,663 steps), 2-3 times/week (8057 steps), and once a week or less (7,539 steps). Mean DS values for children who reported being vigorously physically active for 7 hours or more/week (9,171 steps) were significantly higher than those of children who reported being active for 1 hour/week or less (7,613 steps). However, no significant difference in mean DS was observed between active (8,337 steps) and inadequately active (7,581 steps) children assessed using the HBSC questionnaire.
Discussion
Mean DS was not significantly different between children classified as active and inadequately active based on HBSC criteria, although children who reported engaging in vigorous physical activity every day exhibited higher DS values than other responders. These results indicate that the frequency measure of the HBSC, which may more accurately reflect objective DS, may be more useful for assessing PA status in children than the duration measure. However, the HBSC frequency and duration criteria used to distinguish active and inadequately active children should be revisited, as we observed no significant difference in DS between these groups.
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Contact
Kanzo Okazaki, Ph.D., [kokazaki@mail.tohoku-gakuin.ac.jp]

ACUTE EFFECT OF AEROBIC EXERCISE WITH COGNITIVE STIMULATION ON MEMORY AND SERUM BDNF CONCETRATION IN THE ELDERLY

BARROS, J., NETO, F., MENDES, H., SILVA, R., NASCIMENTO, D., FERREIRA, A., CABRAL, L., MORAIS, M., BOBINSKI, F., COQUEREL, P.
UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE E UNIVERSIDADE DO ESTADO DE SANTA CATARINA - BRAZIL

Introduction
Human aging is characterized by different physiological and functional changes that may be influenced by lifestyle, genetic and environmental factors. Among the consequences of these changes are cognitive deficits, principally memory, affecting the activities of daily life of elderly. Cognitive training intervention combined with exercise has been widely indicated as an alternative to promote cognitive health, however, studies investigating exercise combined with cognitive stimulation are still rare and inconclusive.
Objective
To determine the effects of the combination of single session aerobic exercise with cognitive stimulation over memory performance and increased Brain-Derived Neurotrophic Factor (BDNF) in the elderly.
Methods
This study was characterized as almost experimental, with randomized and crossover design, fulfill with 30 elderly men and women (69.3 ± 5.8 years; 29.7 ± 3.9 kg.cm-²) who were subjected to three different sessions, including two sessions of physical exercise (one with automatic exercise and other with cognitive stimulation) and a control session, each session lasted 50 minutes. The memory was evaluated using the word list test, also serum BDNF was measured from blood sampling immediately before and immediately after each session. After the collection, was found normality and homogeneity of variances. We used two-way ANOVA to compare repeated measures both the concentration of BDNF and as the memory test between sessions and the session itself. We adopted as statistically significant level p <5%.
Results

In relation to memory, the sessions were not different from each other (F (2, 89) = 0.36, P = 0.697, ◦p = 0.008,), however, there was a significant effect in relation to time, indicating that there was a reduction of memory performance in post exercise in all sessions for both the short term memory (control – p = 0.002, automatic – p < 0.001 and exercise with stimulation – p = 0.023) and for work memory (automatic – p = 0.012 and exercise with stimulation – p = 0.015). In relation to the levels of concentration of BDNF, the sessions were not different each other (F (2, 90) = 0.06, P = 0.941, ◦p = 0.001), in the same way, there was no significance in interaction time × session (F (2, 90) = 1.37, P = 0.260, ◦p = 0.029) and in time (F (1, 90) = 0.14, P = 0.712, = 0.002 ◦p).
Conclusion
Moderate intensity aerobic exercise simultaneously with cognitive stimulation is not enough to increase the brain-derived neurotrophic factor, which may negatively affect the performance of memory in tasks performed soon after exercise.
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COMPARATIVE ANALYSIS OF THE CAPACITY OF MOTOR COORDINATION IN CHILDREN WITH HEARING DEFICIENCY

SILVA, A., SOUSA, A., MAGALHÃES, G., BARROS, J.
UNIVERSIDADE DE BRASÍLIA, SECRETARIA DE ESTADO DE EDUCAÇÃO DO DISTRITO FEDERAL, UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

Introduction
The study of the motor coordination is approached in several scientific areas as the motor learning, the motor control and the motor development. This makes possible, to check of the degree of the coordinative development in children and young, and later, to suggest intervention measures to correct the detected inadequacies.
Objectives
In this investigation it's interesting to identify the children with motor weakness or coordination inadequacy. Like this, we intended to characterize the capacity of motor coordination in children and to compare the medium values found among normal children and with hearing loss.
Methodology and Results
The sample was constituted by 40 children distributed equally in two groups denominated study group (GE), with average of age of 8,88 ± 1,22 years, and group control (GC), with average of 9,34 ±1,00 year-old age. The coordination was evaluated through the battery of tests of corporal coordination (Körperkoordinationtest für Kinder - KTK), being the analyzed results, besides the descriptive measures, for the inference statistics ANOVA and the test Kruskal-Wallis.
Conclusions
It is verified that the children with hearing impairment presented medium values of the motor acting inferior to the medium values obtained in normal children of this sample. These results justify the accomplishment of the interventions and futures studies in this population.
Key-word: batery of tests KTK, motor coordination, hearing impairment, motor development.
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IMPACT OF SEDENTARY TIME WITH DECREASING CHRONIC KIDNEY FUNCTION ON DISABILITY IN COMMUNITY-DWELLING JAPANESE OLDER ADULTS: 4-YEAR PROSPECTIVE COHORT STUDY

LEE, S.
NATIONAL CENTER FOR GERIATRICS AND GERONTOLOGY

Background
The purpose of this prospective cohort study was to evaluate the association between renal function and incidence of disability, and to clarified the combining renal function and sedentary time that has the impact on disability among older adults (≥65 years) in Japan.
Methods
We analyzed the cohort data from a entitled National Center for Geriatrics and Gerontology-Study of Geriatric Syndromes. Participants comprised 4,497 community-dwelling older adults who were participated in a baseline assessment from 2011 to 2015 and were followed for 4 years. Estimated glomerular filtration rate (eGFR) was determined according to creatinine levels, and participants were classified into three categories: ≥60, 59-45, <45 mL/min/1.73 m2. Disability defined by Long-Term Care Insurance (LTCI), adjusted for several potential confounders such as demographic characteristics, analysed with Cox regression models for incidence of disability by decreasing renal function. Additionally, we also investigated whether combining eGFR and sedentary time may improve the accuracy of eGFR in predicting disability.
Results
The distribution of participants in each eGFR category (all in mL/min/1.73 m2) was as follows: eGFR ≥60, 3468 (77.8%); eGFR 45-59, 839 (18.8%); and eGFR ≤45, 150 (3.4%). During the 4-year follow-up period, 461 participants (10.3%) began using the LTCI system for incidence of disability. We found that lower eGFR values were significantly increased risk for disability adjusted for potential confounders (HR; 1.74, 95% CI; 1.19-2.54). Combining eGFR and longer sedentary time (≥ 8 hours) significantly more increased the risk for disability incidence (HR; 4.367, 95% CI; 2.021-9.438) than shorter sedentary time (< 8 hours).
Conclusion
eGFR had strong impact on the risk of future disability. Especially, combining with high sedentary time was strongly associated with incident disability in community-dwelling older adults.

RELATIONSHIP BETWEEN THE SUBJECTIVE EFFORT AND THE OBJECTIVE PERFORMANCE IN SMASH ON BADMINTON- IN A CASE OF PARA-BADMINTON PLAYERS IN JAPAN-

KANEKO, M., MORIKAWA, H.

TOYO UNIVERSITY, TEIKYO-HEISEI UNIVERSITY

Introduction

It has been recognized that various adjustments with movements are performed relying on subjective sense and feeling of human. However, it is known that an error occurs between subjective sense and real performance in many cases. Beforehand, grasping the relationship between subjective effort and real performance helps coaches with better coaching. When non-handicapped coach Para-atheletes, grasping the relationship between subjective effort and real performance is all the more. We reported the relationship between the subjective effort and objective performance of the service on badminton in Para-badminton players in this congress of last year. The purpose of this study was to clarify the relationships between the subjective effort and the relative performance in the smash on badminton. This study is a case study for three different badminton players with physical disabled (arms obstacle player, lower limbs obstacle player, wheelchair player).

Methods

The subjects of this study were three well-trained athletes with a physical disabled (upper limbs obstacle player, lower limbs obstacle player and wheelchair player). All the members were male. And they had been higher winning prizes in international badminton meetings. The experimental attempt was the smash in badminton. The subjects performed attempts at five different subjective efforts range 60% to 100% in the sequence of ascending and descending process. Another attempt was the smash in badminton at five different subjective efforts range 60% to 100% at random. The shuttle speed were measured using a high-speed camera (250fps), and an analysis software, FRAME-DIAS(DKH, JAPAN). The relative performance were calculated the ratio of performance for subjective effort 100%.

Results

In case of ascending and descending process, the relative performance corresponded to 74.7、79.5、91.1、100.5、100.0、92.8、83.4、83.7、76.6% in each subjective effort(at five different subjective efforts range 60% to 100%). In case of random, the relative performance corresponded to 75.6、72.6、89.6、92.2、100.0% in each subjective effort.

Discussion

As a whole, the subjective effort and the relative performance produced the error of the excessive tendency in ascending process。In comparison with the service on badminton(KANEKO,MORIKAWA・2016), it was a opposite tendency. It was guessed that this difference was caused by the difference between open skill and closed skill. But we will need detailed examination in future. When we compared the random case to ascending and descending process, the error between the subjective effort and the relative performance in the random was smaller.

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Contact

KANEKO Motohiko （E-mail: mkaneko@toyo.jp）

VALIDATION OF A GERMAN VERSION OF THE CHILDREN'S ATTITUDES TOWARDS INTEGRATED PHYSICAL EDUCATION-REVISED QUESTIONNAIRE

HOOS, O.1, ZIMLICH, M.1, HUBER, A.1, REUTER, C.2, GABEL, H.1, HAUT, L.1

FACULTY OF HUMAN SCIENCES, UNIVERSITY OF WUERZBURG

Introduction

Attitudes of classmates without disabilities play an important role in the successful inclusion of students with disabilities (Block & Obrusnikova, 2007). The Children's Attitudes towards Integrated Physical Education-revised questionnaire (CAIPE-R) (Block, 1995) is one of the most popular means for the assessment of attitudes towards inclusive PE in students without disabilities and has been adapted for different countries (Campos et al., 2013). However, an adapted German version of the CAIPE-R is missing. Therefore, the main purpose of the study was to adapt, translate and validate the CAIPE-R for German PE settings.

Methods

The CAIPE-R-G was developed by 4 APA professionals including an English teacher using an adaptation and forward-backward translation procedure that accounts for trans-cultural differences and was already used to establish a Portuguese version of the questionnaire (Campos et al., 2013). The 11 items (4-point Likert scale) of the CAIPE-R-G were then administered to a sample of n=411 students without disabilities (6th to 9th grade; n=183 females and n=228 males, mean age: 12.7 ± 1.2y), providing the overall attitude score (OVAS), and 2 subscales, the general PE score (GPES) and the sport specific modification score (SSMS) (Block, 1995). Internal consistencies for OVAS, GPES and SSMS were assessed by Cronbach`s alpha, respectively. Exploratory factor analysis (EFA) with robust varimax rotation (eigenvalue >1) and confirmatory factor analysis (CFA) were run to evaluate the factorial structure of the CAIPE-R-G and to assess the goodness-of-fit for the original model by different fit indices (Chi square, CFI, GFI, AGFI, SRMR, RMSEA).

Results

Mean scores for OVAS, GPES and SSMS were 3.32 ± 0.36, 3.20 ± 0.44 and 3.48 ± 0.43 with Cronbach's alpha values of 0.72, 0.67 and 0.56, respectively. EFA revealed a slightly different factorial organization compared to the original structure with a small number of cross loadings. CFA yielded goodness-of-fit indices of Chi square: 168.236, CFI: 0.81, GFI: 0.93, AGFI: 0.89, SRMR: 0.06 and RMSEA: 0.084. The covariance values in the factorial structure of CAIPE-R-G with two unobserved variables ranged from 0.19-0.47 for GPES and from 0.19-0.47 for SSMS.

Discussion

Results indicate that the CAIPE-R-G possesses acceptable consistency and validity to assess attitudes of German students without disabilities towards peers with disabilities in their general PE classes. Thus, the CAIPE-R-G may provide an adequate means for comparative APA research in Germany, e.g. to evaluate the impact of interventions on attitudes toward inclusion (McKay et al., 2015).

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EFFECT ON THE ATTITUDE OF PEERS TOWARDS CHILDREN WITH AUTISM BY INTEGRATION BASKETBALL

HOU, X., ZHU, Z.P., MA, Z.M., FENG, Y.Q., WU, Y.D., TIAN, X.D.
GUANGZHOU SPORT UNIVERSITY

Introduction
Inclusive education is the best education for children with Autism. Peers support is big issue for inclusive education. Therefore, the aim of this study was to investigate the effect on the attitude of peer towards children with autism, using integration basketball activities.
Methods
8 normal children and 8 autistic children, who are aged 6~12 years, were included to participate in a three week (six classes), it is 1.5 hours for every class. Before and after the program, Chedoke-McMaster Attitudes towards Children with Handicaps Scale（CATCH）was used to investigate the emotion and behavior of normal children towards children with autism.
Results
The emotional scores of CATCH of 8 normal children are all increased significantly after intervention ($P < 0.05$). The behavior scores of CATCH of 4 normal children are increased and 4 are decreased, but there is no a significant difference
Discussion
Physical activity is fun and can also increase the chance of communication and cooperation. Basketball is one of the most popular physical activity. The integration basketball activity has a positive role to change the peers attitude towards children with autism, which can be help for inclusive education.
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Contact
lilyhxh@163.com

Biomechanics

CORRELATION BETWEEN ELECTROMYOGRAPHY AND METABOLIC VARIABLES OF WALKING IN CHRONIC HEART FAILURE AND HEART TRANSPLANT PATIENTS

BONA, R.L.1, BONEZI, A.1,2, SILVA, P.F.3, BIANCARDI, C.M.1, CASTRO, F.A.S.2, CLAUSELL, N.O.3
UNIVERSIDAD DE LA REPUBLICA DE URUGUAY

Introduction
Patients with chronic heart failure frequently report intolerance to exercise and present changes in walk pattern (Jehn, et al 2009). Despite the importance of walking speed little is known about heart transplant patients. The energetic cost to walk a given distance - cost of transport (C) (Saibene & Minetti, 2003) in these populations is different from that of health people (Bona, et al. 2016). The aim of this study was to investigate the correlation between the C and electromyographic activity through the sum of muscular groups for specific types of muscular contractions per distance travelled - eletromyographic cost (CEMG), in chronic heart failure (CHF) and heart transplant patients (HT).
Methods
CHF (12), HT (5) patients and control group (CG -12) underwent a C and CEMG protocols, performed on treadmill. Electromyographic data (14 muscles) and oxygen uptake were collected simultaneously at 5 walking speeds, between 5 minutes at each speed, in randomized order: the self-selected walking speed (SSWS), two speeds below the SSWS (-40%and -20%), and two speeds above the SSWS (+40% and + 20%) (Bona, et al. 2016). Pearson correlation was used for to test the relationship between C and CEMG.
Results
Correlations analyses showed positive and strongly association between C and CEMG for CHF ($r = 0.96$; $P = 0.02$), HT ($r = 0.92$; $P <0.001$) and CG ($r = 0.99$; $P = 0.003$).
Discussion
The present study shows a linear correlation between CEMG and C. If the pendulum mechanism explains the most economical speed (Saibene & Minetti, 2003), the CEMG can help to understand the different walking economy in special populations. These results revealed that high or small muscle activity during walking plays a key role in increasing or decreasing the C in these groups. Exercises physiologists have demonstrated the linear relationship between electrical activity and exerted force, for subjects on treadmill at constant speeds (Close et al., 1960). Through the CEMG analysis we can explain the lowest economy of walking of CHF and HT patients, with respect to controls at a given speed. These findings are of great clinical relevance because support the idea that interventions to improve the muscle performance in these patients can increase their economy of walking.
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Contact
renatalbona@gmail.com

BIOMECHANICAL ANALYSIS OF GAIT IN ACTIVE OLDER ADULTS

AIRES, A., PELISOLI, M., TAROUCO, I., VILAR, T., PRINTES, C., MARQUESAN, F., FAGGIANI, F., CASTRO, L., BRANDT, L.A., GOMES, S., IRIGARAY, T., SARTORI, R., BAPTISTA, R.

PONTIFICAL CATHOLIC UNIVERSITY OF RIO GRANDE DO SUL

Introduction
Gait is a low complexity locomotor activity and therefore widely prescribed as an exercise. Motor decline due to aging changes normal gait patterns, causing falls and loss of autonomy in daily life activities (Maki, 1997). Studying Ground Reaction Force (GRF), as well as spatiotemporal gait parameters (velocity, gait length and cadence) are key aspects in determining the health status, risk of falls and the quality of life of the elderly (Hollman, 2011; Sorsdahl et al., 2008).
Methods
The spatiotemporal parameters of gait in 3 men and 26 women (71.62 ± 7.57 years) were acquired using an inertial sensor through 8-Foot Up and Go test. The measure of GRF was determined by 8 force platforms used for the dynamic analysis of movement. Force Profile Score (FPS) values were used to determine the general deviation of the kinetic gait data, which is a sort of Euclidian distance between the force signal developed by the patient and the normative force signal, similar to Gait Profile Score (Baker et al., 2009). The Research Ethics Committee of the Pontifical Catholic University of Rio Grande do Sul (#1.711.680) approved this study.
Results
The mean values of FPS were 21.3 ± 7.9 pts for the right leg and 21.69 ± 5.9 pts for the left leg. This data are 6.5% above the standard values for the left lower limb and 8.43% above the standard values for the right lower limb. The 8-Foot Up and Go test showed a mean of 9.26s ± 2,03s, being within the standard values according to The Senior Fitness Test Manual (Rikli and Jones, 2002).
Discussion
These findings suggest that the elderly have a decline in normal gait, but the active elderly have shown little difference in symmetry between the lower limbs and good results for agility and dynamic balance (Rikli and Jones, 2002). Measuring gait asymmetries can identify pathological gait and still be a reference for the rehabilitation of pathologies that affect human gait. In the elderly, the main factor of risk is associated with the fear of falling and the consequences of the fall. The results confirm that physical activities improve balance, mobility, and reduce the risk of falls, improving the gait of the elderly (Baker et al., 2009).
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Contact
agaires@gmail.com

EXTERNAL FORCES IN LONG STRETCH FRONT EXERCISE OF PILATES PERFORMED IN REFORMER

BONEZI, A.1,2, BONA, R.L.1, LOSS, J.F.2

UNIVERSIDAD DE LA REPUBLICA URUGUAY

Introduction
The effects that external forces have on human body are important for learning movemens and understanding the exercise mechanics. Springs are the external resistance in Pilates method (PM) (Cantergi et al, 2015). Modifing the springs interfere with the movement stability changing the exercise's external demands. The aim of this study was to estimate and compare the external forces during long stretch front exercise (LSF) performed on reformer apparatus.
Methods
Sample was composed by 15 advanced Pilates (AP) practitioners and 15 beginner (BP) paired by mass, age, height and gender. Each subject performed 10 repetitions of LSF with one and two spring resistance on reformer at self-select speed. The LSF may be characterized as shoulder extension against the springs on reformer. Kinetics data were measured using an instrumented and a calibrated footbar on reformer (Cantergi et al, 2015). Four load cells capable of measuring the direction and magnitude of the force exerted of movements were attached to the reformer's footbar. Data were processed using a 4th order and low pass filter, cut-off frequency 5 Hz. One way repeated Anova were used.
Results
The groups had the same anthropometric characteristics. The means of peaks magnitude force showed significant differences between BP (30.5 N) and AP (25.9 N). The direction of force during the exercise was different too.
Discussion
These results were probably due to differences in intrinsic motor control and practice of PM. Unstable tasks, like LSF, require learning control mechanism by careful integration of multi joint coordination with stabilization tissue. It is known that excessive forces are harmful, potentially causing injuries on the upper limb joint and their reduction can be beneficial (Van Den Bogert, 1994). The AP group tended to minimize the loading, and to select the motor control strategies (for example a mixture of stiffness strategy, feedback strategy, and feed-forward strategy) necessary for the movement (Morasso et al, 2014). Thus the knowledge of forces involved in an exercise permits a better definition, contributing to more careful choices and a better prescription of the exercise (Cantergi et al.2015). From these base it is possible to continue the analysis and determine the joint forces on shoulder and spine, using inverse dynamics approach.
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Contact
abonezi@cup.edu.uy
1:UDELAR,CENUR (Paysandú, Uruguay), 2: UFRGS, ESEFID (Porto Alegre, Brazil)

A BIOMECHANICAL ANALYSIS OF INSTEP SHOOTING IN WOMEN SOCCER PLAYERS

JIN, Y.
UNIVERSITY

Introduction
The Purpose of this study was to do instep shooting in the condition that ball stand, rolls on, and rolls to player considered shooting was almost done in the dynamic situations.
Methods
Subjects were players in women high school (10 players, 17-19ys) and 3-Dimensional Cinematography and Force Platform methods were used for research. Relative angles were calculated through Cardan Angles, which is frequently used in biomechanics and the moment was found with Motion-dependent interaction analyzing method which was used by Feltner and Dapena. Through such methods it was assumed that "the results of the kinematic and kinetic factors are the same" and after compiling statistics with One-Way ANOVA and post hoc testing with Tukey's Honestly Significant Difference method.
Results and Discussion
There is significant difference statistically in projection velocity, foot velocity and another kinematic variable. The angle of incidence didn't have much differences. When comparing the means, the results came out first, of the ball rolling away, second, of the ball rolling towards, and third, of the ball standing still, in the order of greater angles. The three movements showed no differences in the change of the relative angles of the upper leg. If we watch the relative rotation angle of the upper leg at time of impact θ1 appeared greater in the order of the ball standing still. Rolling away, and rolling towards the player. The angle showing a slight difference in the shooting movement of the ball standing still was due the angular speed of the thigh. We could tell that the impact occurred at abduction state from θ2 showing a negative figure in all three cases. The fact that the impact occurred even when the ankle was at abduction state should be noticed. This supports the fact that the movement takes place when whole leg is at abduction state during the instep shooting. θ3 showed greater numbers in the order of the ball rolling towards the player, standing still, and rolling away from the player. On impact, peak of force in Fy(medio/lateral force) in three motions is shown to take out faster than in Fx(anterior/posterior force). Fy and Fx were related with approaching angle and also have effect on the velocity of ball. Fz(vertical reaction force) showed some differences in each of three movements($p<0.05$). And post hoc test showed differences between the ball standing still and rolling away and between the ball rolling away and rolling toward the player.

THE BODY SWAY AND STABILITY WHILE PERFORMING 7 CORE MUSCLES MOVEMENTS FOR ATHLETES WITH MILD LOWER BACK PAIN

LO, C.L., CHENG, S.C., CHANG, H.Y.
CHENG CHING GENERAL HOSPITAL, NATIONAL TAIWAN SPORT UNIVERSITY, CHUNG SHAN MEDICAL UNIVERSITY

Introduction
The core stability and core muscle strengthening has become a popular kind of physical training. The training program should be based on the results of the assessment of core muscle ability before training. The pressure biofeedback (PBF) unit can be used to quantify the stability of neuromuscular control on core muscles. PBF unit is cheaper and easier to carry then using electromyography assessment. Researchers found that well trained and experienced rater showed better reliability while using PBF unit assessed. Hence, experienced raters and novices in the core muscles assessment would be the difference because of their experience. Based on the above reasons, the development of a validity methods of the core muscles assessment for athletes is necessary. Therefore, the purpose of this study was to develop a reliable and practical method to assess the core muscle ability for athletes by comparing the results of two core muscles assessments using force platform system and PBF unit.
Methods
Sixteen athletes (height: 168.4±10.0 cm, weight: 64.3±16.9 kg; age: 24.5±1.8 years old; Oswestry scale: 21.4±8.5) with mild low back pain are recruited in our study. All participants perform 7 different core muscle movements during testing, including plank, right/left side plank, quadruped with right hand/left leg raise, quadruped with left hand/right leg raise, and bridging with right/left leg raise. Each movement should be maintained for 10 seconds on the force plate. The Zebris force platform system was used to record the area and path length of center of pressure (CoP) of body sway, and the pressure biofeedback unit was used to test the core muscle stability.
Results
The results showed a significant positive correlation between the data that measured by PBF and the path length of the CoP that measured by force plate in most of testing conditions ($p<.05$), except quadruped with right hand/left leg raise. Other movements showed low to moderate correlation ($r = 0.307 \sim 0.513$).
Discussion
The core stability assessment can be divided into the following two categories, manual test and instrument testing. The instrument testing included the EMG instrument and the pressure biofeedback (PBF). PBF device equipment costs lower, but the user needs to practice and familiar with the process to test. It was not suit for novices to operation. Hence, using force plate to detect the body sway while performing core muscles movement in present study may be a suitable methods for novice. The present study also showed the lower to moderate positive relationship between path length of CoP on force plate of these 7 core muscle movements and PBF data. In conclusion, the path of CoP on force plate of these 7 core muscle movements can be used as an assessment tool for the core stability of athletes in clinical setting.
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Contact
yun1130@csmu.edu.tw

MUSCLE ACTIVITY DURING RHYTHMIC EXERCISE WITH A BALANCE BALL

NAKAMURA, M.
KOGAKKAN UNIVERSITY

Introduction

Stability ball exercise is an effective way to improve strength, balance, and endurance. It also contributes to maintaining health and to injury recovery, because it does not generate a large impact force on the body. Although stability ball exercise involves balancing on an unstable surface, most people find that it is easy to perform and gives a sense of accomplishment. However, given that only a few simple movements are repeated, it may not generate the same level of excitement as other activities. We hypothesize that performing stability ball exercise along with music would increase participants' excitement and enjoyment. As a first step, this study investigated muscle activity during rhythmic stability ball exercise.
Methods
Thirteen women performed various stability ball exercises with rhythms of 1.3 Hz, 1.5 Hz, and 1.7 Hz. The electromyographic (EMG) activity of seven muscles of the right lower limb was measured, and the participants were asked to evaluate their perceived exertion, degree of fatigue, and enjoyment of the exercise.
Results
EMG activities of the vastus lateralis and medialis and erector spinae muscles increased as the torso descended and then returned to its initial position on the ball. During combined movements in which the body was bounced up and down while the torso was twisted from front to back and left to right, the EMG activity of the rectus abdominis, obliquus externus, and gluteus medius also increased. When the trunk was moved without bouncing, a low level of EMG activity was still found. In their self-evaluations, all participants replied that rhythm exercise using a stability ball was enjoyable and did not leave them feeling fatigued.
Discussion
Bouncing the body on a stability ball increased the EMG activity of the lower limb muscles more than seated balancing on the ball. EMG activity of the trunk muscles increased when bouncing was combined with torso twists, suggesting that twisting the trunk improves its stability. Thus, exercise that involves moving the upper body while bouncing on a stability ball may effectively activate muscles and improve balance ability, especially for elders who have poor dynamic balance. It has been reported that ball exercise improves balance ability during dynamic movement (Sakai et al.,2012). Static exercise while sitting on a ball may also be effective for improving balance without generating a large impact force, because muscles such as the erector spinae continued to be active during such movements in the present study. In conjunction with the participants' self-evaluations, these findings suggest that the combination of stability ball exercise and rhythmic movement could be an effective way for individuals to actively engage in exercise.
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SYNCHRONIZATION BETWEEN BEAT AND BASIC RHYTHMIC MOVEMENT IN HIP-HOP DANCE

SATO, N., NUNOME, H., IKEGAMI, Y.
NAGOYA GAKUIN UNIVERSITY

Introduction
Hip-hop dance is a freestyle dance form performed to the beat of hip-hop music. Like other dance genre, synchronization between the beat of the music and the dance movements is of an important aesthetic element in hip-hop dance. Although it was reported that expert dancer's performances include some common motion characteristics which are linked to higher evaluations by judges (Sato et al., 2015), no attempts have been made to investigate on how much the hip-hop dance movements synchronize with the beat of the music. The purpose of this study was to examine the synchronization between the hip-hop dance movements and the beat of the music, and to extract some motion characteristics which are common to expert dancers.
Methods
Eight expert (experts) and eight non-expert (non-experts) hip-hop dancers participated in this study. In the down technique of the basic rhythmic movement, the dancers use their downward body motion to synchronize with the downbeat of the music. All the dancers were asked to perform the down technique to a metronome beat of 100 beats per minute. Their dance movements were captured by a motion capture system, and the signal of the metronome was simultaneously recorded. Several kinematic parameters including the knee flexion angular velocity and the velocity of vertical displacement of the head were calculated. The time lags between the beat and those parameters were calculated and it was represented as a relative value against one whole movement cycle that corresponds to 100%.
Results
The time lag between the peak of knee flexion angular velocity and the moment of the beat was significantly smaller in the experts than in the non-experts (3.3 ± 7.1 % vs. 14.6 ± 10.9 %). The vertical head velocity of the experts at the beat moment was significantly higher than that of the non-experts.
Discussion
The moment of the beat approximately matched with the peak of the knee flexion angular velocity among the experts while the non-experts failed to match their peak knee flexion angular velocity with the moment of the beat. These results indicated a clear difference of the way of synchronization to the beat of music between the experts and non-experts. Also, the difference of the knee motion might induce a distinctive difference of head vertical velocity. As Sato et al, (2015) reported, characteristic head movements seen in expert dancers are most likely linked to higher judging evaluations. Thus, the high speed head vertical motion seen in the experts may form preferable features of the down technique in hip-hop dance.
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Contact
nsato@ngu.ac.jp

MOTION ANALYSIS OF SINGLE-LEG ECCENTRIC DECLINE SQUATS ON A DECLINE BOARD

MITANI, Y.1, KOYANAGI, M.2, NAKAE, N.3, SAKAI, T.4, MATSUO, T.5, KIMURA, Y.6
1: KANSAI UNIV. OF WELFARE SCI. (OSAKA, JAPAN), 2: OECU (OSAKA, JAPAN), 3: KANSAI MEDI. HOSP. (OSAKA, JAPAN), 4: OHSU (OSAKA, JAPAN), 5: OSAKA YUKIOKA COL. OF HEALTH SCI. (OSAKA JAPAN), 6: OSAKA UNIV.

Introduction
Single-leg eccentric decline squats on a decline board (DB) reportedly increase quadriceps muscle activity and knee extension moment (Richards et al., 2008; Zwerver et al., 2007). However, the mechanism of these effects is unknown, and there has been insufficient investigation of the most effective DB angle. This study aimed to measure body movement during single-leg eccentric decline squats on a DB set to various angles, and to compare data for kinematics and kinetics at each setting.

Methods
Eleven healthy male university students performed single-leg eccentric decline squats on a DB set at 0°, 5°, 15°, and 25°. High-speed cameras, a force plate, and surface electromyography were used to measure body movements. The lower extremity joint angles, moments, muscle activity (percent maximum voluntary contraction: %MVC), and center of gravity (COG) and center of pressure (COP) position were measured. The data were analyzed by one-way ANOVA followed by Tukey's post hoc test. Significant level was set at 0.05.
Results
An increase in DB angle resulted in increased muscle activity of the rectus femoris (DB 0°: 38.2 ± 15.5%, DB 5°: 41.4 ± 11.4%, DB 15°: 51.9 ± 16.9%, DB 25°: 61.8 ± 10.6%), vastus medalis (DB 0°: 78.6 ± 25.9%, DB 5°: 82.6 ± 24.9, DB 15°: 94.4 ± 31.0%, DB 25°: 113.5 ± 56.8%), and vastus lateralis (DB 0°: 61.0 ± 9.7%, DB 5°: 63.0 ± 12.6%, DB 15°: 70.2 ± 16.6%, DB 25°: 85.3 ± 31.2%), and knee extension moment (DB 0°: 1.53 ± 0.19 Nm/kg, DB 5°: 1.60 ± 0.21 Nm/kg, DB 15°: 1.77 ± 0.17 Nm/kg, DB 25°: 1.90 ± 0.16 Nm/kg) ($p < 0.01$). Increased DB angle also resulted in increased knee flexion angle, and thigh posterior tilt angle ($p < 0.01$), and decreased knee valgus angle ($p < 0.01$). In addition, increased DB angle resulted in posterior displacement of the COG and COP ($p < 0.05$).
Discussion
Increasing the DB angle increased quadriceps muscle activity and knee extension moment. Increase in DB angle may generate forward rotation moment in the body, increasing the thigh posterior tilt angle, and resulting in posterior displacement of the COG and COP to control posture. These results suggested that posterior displacement of the COG and COP increased the knee extension moment and quadriceps muscle activity. In addition, increased DB angle decreased the knee valgus angle, indicating decreased mechanical stress in the knee joint on the frontal plane during squats.
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Contact
mitani@tamateyama.ac.jp

CHANGES IN FUNCTION OF TENDON TISSUE IN RESPONSE TO CONTINUOUS STRETCHING OF THE MUSCLE-TENDON COMPLEX

SOMA, Y., NAKAMURA M., INADA T., OTANI D., OGISO K.
KOGAKKAN UNIVERCITY

Introduction
Physical training improves the stiffness, maximum stress, and force required to rupture tendon tissue. However, repeated stretching of the muscle-tendon complex (MTC) may worsen them. The aim of this study was to investigate the effects of repeated stretching of the MTC on the function of tendon tissue.
Methods
Fourteen male participants performed a maximum voluntary isometric contraction (MVIC) of the ankle joint at an angle of 90 deg. After a rest period of 5 min, the ankle was dorsiflexed 800 times continuously. The ankle joint was passively rotated from 120 deg to 70 deg at 300 deg/s. The ankle was dorsiflexed 800 times in the relaxed right leg (R-condition) and in the left leg under electrical stimulation (ES, E-condition). The intensity of ES was set to 10% of the MVIC and the frequency was 20 Hz. MVIC was measured immediately after the end of dorsiflexion and 5 and 10 minutes later. The subjects then self-evaluated their MVIC performance and reported the degree and location of muscle soreness.
Results
After dorsiflexing the ankle 800 times, the MVIC torque was significantly decreased in both conditions, whereas the distance moved by the deep aponeurosis, tendon stiffness, and pennation angle (PA) of the gastrocnemius medialis muscle remained unchanged. The plantar flexion torque and distance moved by the deep aponeurosis decreased significantly from the 1st to 10th dorsiflexion and 101st to110th dorsiflexion in the E-condition. The PA nearest to the deep aponeurosis decreased significantly from the 1st to 10th dorsiflexion, and was significantly larger than the other PAs from the 1st to 10th dorsiflexion and 201st to 210th dorsiflexion in both conditions. The subjects' self-evaluation of MVIC after dorsiflexing the ankle 800 times decreased in both conditions. Muscle soreness occurred at the myotendinous junction in the E-condition and was more severe than in the R-condition.
Discussion
Dorsiflexing the ankle 800 times did not change the behavior of the fascicles, but decreased the MVIC torque and made it more difficult to perform an MVIC. The larger decrease in MVIC torque and severe muscle soreness at the myotendinous junction observed in the E-condition suggests that the myotendinous junction might be involved in the decreased MVIC torque. The fascia plays an important role in transmitting the force generated by one muscle to another. Therefore, repeated passive stretching of the MTC might affect the connective tissue around the myotendinous junction, thereby decreasing the MVIC torque and making it more difficult to perform an MVIC.

RELATIONSHIP BETWEEN TRUNK KINEMATICS AND STEP WIDTH DURING PITCHING MOTION IN ADOLESCENT BASEBALL PLAYERS

TANAKA, M.
NIIGATA INSTITUTE FOR HEALTH AND SPORTS MEDICINE

Introduction
Baseball pitching is combined motion coordinated by each joint of the lower extremities, trunk and upper extremities at an appropriate timing. Because the duration from the late cocking phase to the acceleration phase is very short and the coaching for this phase is difficult, the effective guiding principal considering the kinetic chain in the early cocking phase is required. Therefore, we focused on the early cocking phase of pitching motion in the adolescent baseball players, and the three-dimensional motion analysis was performed. The aim of this study was to investigate the pitching kinematics of adolescent baseball players and compared its changes with growth periods.
Methods
Three-dimensional pitching kinematics data of upper and lower extremities, thorax and pelvis of 184 male baseball players in growth period (mean age, 13.7 years; range, 8 to 18 years) were evaluated. Pitching kinematics during fastball throwing were three dimensionally analyzed using a motion capture system and high speed camera. According to previous studies (Dillman et al., 1993; Fleisig et al.,

1999), pitching motion was divided into four instants: knee high position of stride leg (KH), foot plant on ground of stride leg (FP), maximum external rotation of shoulder joint (MER) and ball release (BR). The duration from KH to FP was defined into the early cocking phase. Correlation coefficient between (1) age and the stride width, (2) age and the posterior tilt of thorax, and (3) age and the rotational difference between pelvis and thorax (differentiated trunk rotation: Stodden et al., 2006) at FP were evaluated.
Results
(1) Significant negative correlation ($r = -0.38$, $p < .000$) was observed in age and the stride width. (2) Moderate negative correlation ($r = -0.46$, $p < .000$) was found in age and posterior tilt of thorax. (3) Age and rotational difference between pelvis and thorax at FP were significantly correlated ($r = 0.5$, $p < .000$).
Discussion
Baseball pitching is a high demand athletic skill requiring a complex motion of whole body. The results of present study indicate that age difference of pitching kinematics will be affected by immature rotational motion including posterior tilt of the trunk and less control of the lower extremities during pitching motion (KH to FP). Also out step to non-throwing side and posterior tilt of the thorax were considered to be the cause of improper kinetic chain from the lower extremities to pelvis and thorax. Therefore, the posterior tilt of the thorax at FP should be corrected neutral position and the stride direction should be matched along axis leg and foot for pitching direction.
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Contact
m.tanaka@ken-supo.jp

INDIVIDUAL SCRUMMAGING PERFORMANCE IS NOT REDUCED FOLLOWING A SIMULATED RUGBY UNION MATCH

GREEN, A., KERR, S., OLIVIER, B., DAFKIN, C., MEIRING, R., MCKINON, W.
UNIVERSITY OF THE WITWATERSRAND

Introduction
The 80 minutes of strenuous exertion during a rugby union game hard felt by all players. In particular, forwards are required to participate in the arduous activity of scrummaging throughout a game. The purpose of the study was to identify whether match induced fatigue modified individual scrummaging technique and reduced performance.
Methods
Twelve forwards (body mass 106.2±13.3 kg; stature 179.5±8.4 cm) had individual scrum kinetics and kinematics assessed prior to and following a protocol that simulated a rugby match.
Results
The simulated rugby match protocol required participants to run at various velocities and perform rugby specific tasks. Rating of Perceived Exertion (RPE) was assessed using a 6-20 Borg scale and Visual Analogue Scale (VAS). Blood lactate, heart rate and RPE were measured prior to, mid-point and after the simulated game, while markers of muscle damage (blood creatine kinase (CK) and urea) were measured prior to and following the protocol. RPE ($p<0.0001$) and VAS ($p<0.0001$) showed significant increases between the pre- and post-simulation values. Of the physiological markers, heart rate ($p<0.0001$) and blood urea concentration ($p=0.004$) increased following the simulation. No significant differences were observed for blood CK ($p=0.281$), individual scrummaging forces ($p=0.433$) or in the kinematic variables following the protocol.
Discussion
While psychological and physiological fatigue may develop during a rugby simulation, no differences were observed in peak forces or in body kinematics at peak force. This lack of difference may suggest that individual strategies for attaining peak force may compensate for fatigue.

SPECIFICITY OF RANGE OF MOTION IN ISOKINETIC STRENGTH TRAINING

INADA, T., NAKAMURA, M., YANO, S., OGISO, K.
KOGAKKAN UNIVERCITY

Introduction
Isometric strength training increases the force about the joint angle at which the muscle contraction is performed (Miyazaki et al.,2010). The movement, velocity, intensity, and duration of physical training are usually affected by neuromuscular adaptation, particularly when muscle length is shorter. This study was designed to investigate the effects of range of motion (ROM) in isokinetic strength training on improvement of the maximum voluntary isometric contraction (MVIC) at various joint angles, independent of neuromuscular adaptation.
Methods
Sixteen men participated in 4 weeks of isokinetic training (90 deg/s) consisting of 100 passive knee extensions and flexions performed three times per week with electrical stimulation to avoid involvement of the central nervous system. The participants were divided into two groups: Group A performed the training at a ROM of 0–45 deg, and Group B at a ROM of 45–90 deg (full knee extension = 0 deg). Electrical stimulation was applied to the quadriceps femoris muscle at a frequency of 20 Hz and an intensity corresponding to 20% of the MVIC torque generated by knee extension to 45 deg (4.7 ±1.4 mA). MVIC torque of the knee extension was measured at knee joint angles of 22.5, 45, 67.5, and 90 deg before training and then once per week until the end of the training period.
Results
Group A showed significant increases in MVIC at 22.5 deg after 2 weeks of training and at 45 deg after 3 weeks, but showed no significant increases at 67.5 deg or 90 deg throughout the training period. Group B showed significant increases in MVIC at 67.5 deg and 90 deg after 2 weeks of training, at 45 deg after 3 weeks, and at 22.5 deg after 4 weeks.
Discussion
In this study, strength training performed with greater knee flexion increased MVIC torque over a wider range of knee joint angles. This suggests that training with the muscle in a more stretched position may lead to an increase in MVIC torque over a wider range of joint angles. Because the training was performed passively with electrical stimulation, the results were not due to neural adaptation. Joint torque is affected by the length-force relationship of muscle fibers, and length of the moment arm (Hukunaga and Kawakami, 2001; Takisita et al.,2015). Maximum force is exerted at a knee joint angle of about 70 deg; (Takisita et al.,2015) thus, Group B trained near the

optimal joint angle. This may also be related to the increased MVIC torque at various joint angles observed in Group B. In conclusion, the effects of strength training are largely influenced by the ROM in which the training is performed, independently of neural adaptation.
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METHOD OF THE STABILOGRAM ANALYSIS FOR RESEACH OF THE BALANCE STABILITY IN SPORT

ANGELOV, V., TISHINOV, O., GOTOVA, J., ALBERT, E., STOIMENOV, E., HRISTOV, V.
NATIONAL SPORTS ACADEMY

Introduction
The balance stability in the sport and lifestyle of the people is an important and significant problem. It is an essential component of successful sports-technical realization. In this paper, we present an algorithm for conducting an apparatus study of the balance stability using the method of stabilogram analysis. This method enables the assessment of neuromuscular, proprioceptive, visual and vestibular systems and ranks alongside the famous medical methods for blood tests, electrocardiography and others.
Methods
The aim of this work is to create an algorithm for assessment and analysis of the postural stability of the athletes using instrumentation methods. The scientific methods, used for the implantation of the study are stabilogram analysis, mathematical and statistical processing and data analysis, pedagogical surveillance etc. The construction of the posturographic platform and the algorithm for data analysis is an authoring elaboration made by Bulgarian team (Tishinov O. et al., 1980). The method is patented in Bulgaria – AS33600/1983. The contingent of the study includes professional ballet dancers, acrobats, gymnasts, yoga instructors, practitioners of karate, Qigong and a group of non-sports participants.
Results
The results concerning the movements of the projection of Center of gravity on the posturographic platform are presented through graphics and tables. They reflect data collected in two mutually perpendicular directions – frontal (X) and sagittal (Y). For purposes of the analysis the aggregate result (Z) from the two directions is taken.
Discussion
So far the results of the posturographic measurements are analyzed solely on the basis of the statistical processing of the collected data. We offer an advanced algorithm for interpretation of the stabilograms. It includes: amplitude analysis, frequency analysis, graphical model built on the base of peak values, newly created factor of balance that reflects the relationship between the average amplitude and frequency fluctuations. The proposed algorithm allows detailed analysis of the collected data. The created balance factor allows the use of a differentiated approach when applying the results of the research into practice through specific methodological recommendations.
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Contact
angelov.vl@gmail.com

VARIABILITY IN STRENGTH EXERCISE WITH ROTATIONAL INERTIA DEVICE UNDER DIFFERENT LEVELS OF CONSTRAINTS

FERNÁNDEZ-VALDÉS, B.1, GISBERT, J.F.1, CATALA, J.1, VÁZQUEZ-GUERRERO, J.1, MORAS, G.1
1: NATIONAL INSTITUTE OF PHYSICAL EDUCATION OF CATALONIA (BARCELONA, SPAIN)

Introduction
Team sports are characterized by high speed running while a ball is carried, passed, kicked or thrown (1). The vast majority of these movements require acceleration and deceleration (2). This study aimed to compare the variability of professional rugby players while they performed horizontal forward and backward resistance displacements (HD) with a rotational inertial device (RID) with the same exercise while catching and throwing a rugby ball and performing forward displacements (HDB) using Approximate entropy (ApEn). ApEn is a mathematical algorithm used to quantify the amount of regularity and the unpredictability of fluctuations over time-series data (3).
Methods
Twelve professional rugby players (mean ± SD: age 25.6 ± 3.0 years, height 1.82 ± 0.07 m, weight 94.0 ± 9.9 kg). Players performed two series of eight repetitions of HD and HDB at random. In order to avoid confusion variables, execution rhythm and displacement were controlled using a metronome and the same rope length. The RID (Byomedic System SCP, Barcelona, Spain) consists of a metal flywheel (diameter: 0.42 m) with up to 16 weights (0.421 kg and 0.057 m diameter each). The acceleration of the rugby players under both conditions was measured using an inertial measurement unit ((WIMU,Realtrack Systems, Almeria, Spain).
Results
No mean acceleration differences were found between HD and HDB. There were significant differences in ApEn between HD and HDB in the entire time-series signal ($p = 0.001$) and forward movement ($p = 0.020$), but not backward displacement. The effect size for ApEn in the overall and forward displacements were > 0.8 (large) (4).
Discussion
ApEn was higher for HDB than for HD. Using this algorithm, differences were detected between the conditions and can be used to establish the amount of perturbation under different levels of constraint. Entropy as a nonlinear measurement makes it possible to establish the regularity and complexity of the signal, aspects that cannot be detected using linear tools alone.
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Contact

brunofvaldes@gmail.com

THE RELATIONSHIP BETWEEN MUSCULAR STRENGTH ASYMMETRIES AND FORCE PRODUCTION ASYMMETRIES AMONG SOCCER PLAYERS

MISJUK, M., RANNAMA, I.

TALLINN UNIVERSITY

Introduction

The game of soccer involves frequent one-sided activities, which may lead to muscle strength asymmetries between two legs (Kellis et al., 2001). Bilateral muscle asymmetries between legs may reduce performance (Fousekis et al., 2010). There are many studies that investigate relationship between muscle strength and jump height, but there is lack of studies that investigate relationship between local muscle strength and force production during multi joint maximum performance.

The purpose of this study is to investigate relationship between local muscle strength asymmetry and muscular power production asymmetry during vertical jumping.

Methods

The study consists of 17 male soccer players from Estonian Premium League teams (24.1±7.5yrs, 178.8±7.5cm, 73.8±9.1kg). The participants performed squad jump (CMJ) and countermovement jump (CMJ) in two Kistler force plates. The study analyses the best result out of the three attempts of the right and the left leg in SJ and CMJ. Knee extensors (EX) and flexors (FL) peak torque (PT) was measured with an isokinetic dynamometer Humac Norm (USA). Concentric actions were measured at angular velocity of 60 and 300°/s, and eccentric (ECC) actions at angular velocity of 60°/s. The body side directive asymmetry indexes (ASI=100*(L-R)/max[L;R]) were calculated and Pearson correlation analyse was conducted between local muscle strength ASI and jump power asymmetry.

Results

The main finding of the study is that there is a statistically significant correlation between strength asymmetries of knee flexors eccentrically at angular velocity of 60 °/s and maximum power asymmetry. The maximum power asymmetry was measured for two jumps; for the squat jump the correlation with knee flexors was 0.682 ($p<0.01$), for the countermovement jump the correlation with knee flexors was 0.484 ($p<0.05$).

Discussion

The results of present study indicate that the amount and direction of knee flexors eccentric strength asymmetry is moderately related with jump power production asymmetry. Earlier studies have focused more on extensors strength asymmetry and performance (Yoshioka et al., 2011). Our study demonstrates that the bilateral differences in elastic component of hamstrings muscles and also the compromised muscle activity patterns of this biarticular muscle group can play important role in asymmetrical power generation mechanics during vertical jumping.

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THE ACUTE EFFECT OF AEROBIC EXERCISE WITH COGNITIVE INTERFERENCE ON BALANCE DUAL-TASK PERFORMANCE

MOREIRA-UMAÑA, J., SCAGLIONI-SOLANO, P., PERALTA-BRENES, M.

UNIVERSITY OF COSTA RICA

Introduction

In humans, several activities of daily living involve maintaining posture while the brain simultaneously performs infinite cognitive tasks (CT). Gait and postural control are motor activities diminished when dual-tasks (DT) are performed. Research has shown that exercise along with other task could improve DT performance. Therefore, the aim of this study was to analyze the effect of an aerobic training session along with cognitive interference (CI) on a balance DT situation in university students.

Methods

Participants were 15 male (24.5 ± 2.0 yr.) university students who did a control (CON) and an experimental condition (EXP). The CON consisted in sitting quietly. The EXP consisted in one session with 5-min of warm-up, 20-min of continuous aerobic exercise with CI at 65-70% maximal heart rate and 5-min of cool-down. Static (SB) and dynamic balance (DB) were measured before (pre-test) and after (post-test) each condition using double-leg with open (SBO) and closed eyes (SBC) (Shiravi et al, 2017) , On a Wii-Balance Board for SB (displacement of the center of pressure, CoP) and walking speed on 10-m for DB (Watson, 2002), all DT activities with a CT task. Normality test, two-way ANOVA (treatments x measurements) and follow-up were used for SB and DB variables.

Results

No significant interactions were found between treatments (CON = 0.5 ± 0.1-m vs. EXP = 0.5 ± 0.1-m, $p>0.05$) and measurements (Pre-test= 0.5 ± 0.1-m vs. Post-test = 0.5 ± 0.1-m, $p>0.05$) on SBO, treatments (CON=2.1 ± 0.1-m vs. EXP = 2.1 ± 0.1-m, $p>0.05$) and measurements (Pre-test= 5.0 ± 0.1-m vs. Post-test = 5.0 ± 0.1-m, $p>0.05$) on SBC, and treatments (CON=2.1 ± 0.4-m/s vs. EXP = 2.1 ± 0.4-m/s, $p>0.05$) and measurements (Pre-test= 2.0 ± 0.3-m/s vs. Post-test = 2.1 ± 0.4-m/s, $p>0.05$) on walking speed. No significant main effects were found on any condition on SB ($p>0.05$) and walking speed on DB ($p>0.05$).

Discussion

One session of aerobic exercise with cognitive interference did not affect SB and DB on DT. The DT situations overstrain cognitive capabilities, resulting in motor performance decrements (Beurskens et al, 2016). Intervention studies involving cognitive, motor or dual-task training showed changes in important gait parameters and balance under dual-task contexts, different to this research. This could be because the stimuli were not strong enough to modify the cortical regions. (Salazar-González et al, 2014).

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Contact

jpmucp@gmail.com

FLEXOR HALLUCIS LONGUS MUSCLE ELECTROMECHANICAL ACTIVITY DURING DIFFERENT WALKING TASKS- PRELIMINARY RESULTS

PÉTER, A.1, JUSSILA, J.1, CRONIN, N.1, ALKJAER, T.2, FINNI, T.1

1 UNIVERSITY OF JYVÄSKYLÄ, 2 UNIVERSITY OF COPENHAGEN

Introduction

Flexor hallucis longus muscle (FHL) is a deep ankle plantar flexor, which has many functions e.g. maintenance of the medial longitudinal arch. In previous studies, high inter-individual differences were found in force transmission mechanisms between triceps surae and FHL (1), in the use of FHL during isometric plantarflexion (2) and force production of toe flexors (3). These studies involved small sample sizes. Thus, in this ongoing study we aim to collect data from a large subject group to examine whether high inter-individual variability of FHL function exists during different walking tasks.

Methods

To date, 12 healthy students have participated voluntarily in this study. After placement of bipolar surface EMG electrodes over the FHL, medial and lateral gastrocnemius, soleus and tibialis anterior muscles, subjects performed 7 different overground walking tasks: shod, with flip-flops and barefoot walking at preferred speed, 30% faster and 30% slower than preferred speed with shoes, matched barefoot and matched with flip-flops (same speed as shod preferred). They then performed maximal ankle dorsi- and plantar flexion contractions and maximal big toe flexions superimposed on ankle plantarflexion in an isokinetic dynamometer for the purpose of EMG normalization. EMG signals were band-pass filtered between 20 and 450 Hz. Root mean square (RMS) activity was calculated for each muscle in the stance phase of the step cycle. FHL activity relative to that of the triceps surae muscles was calculated to determine the relative contribution of FHL to each walking task.

Results

The FHL/MG activity ratio in slow walking was significantly lower than in flip-flops at matched speed ($p=0.006$), preferred speed walking ($p=0.007$) and fast walking ($p=0.001$). In slow walking FHL EMG activity was significantly lower than at preferred speed ($p=0.001$), fast walking ($p<0.001$), flip-flops at matched speed ($p=0.002$) and barefoot walking at matched speed ($p=0.005$). Additionally, we found high inter-individual differences in the use of FHL, with no consistent changes across individuals between different walking tasks.

Discussion

These preliminary results highlight the need for high-sample size analysis to define sub-groups in terms of the use of FHL during walking. Potential reasons for the large differences between individuals may include the multi-functional nature of FHL, as well as the anatomical characteristics of the foot.

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Contact

annamaria.a.peter@jyu.fi

MECHANICAL PROPERTIES OF GASTROCNEMIUS MUSCLE AND ACHILLES TENDON IN PLANTER FLEXION

YOKOZAWA, S.1, IMAWAKA, T.1, TANAKA, S.2, DJORDJEVIC, S.3, TSUNODA, N.1

1: GRADUATE OF SPORT SYSTEM, KOKUSHIKAN UNIVERSITY (TOKYO, JAPAN) 2: KOKUSHIKAN UNIVERSITY (TOKYO, JAPAN), 3: UNIVERSITY OF PRIMORSKA (KOPER, SLOVENIA)

Introduction

In previous studies, it appeared, that the muscle contraction (MC) sensor was very useful to evaluate the mechanical property of muscle-tendon complex in performing dynamic exercise. In addition, there was a report saying, that MC signal as a mechanical property was somewhat correlative with elbow flexion force in isometric condition as well (Djordjevic et al., 2014, 2011). The relationship between mechanical properties of knee extensor muscles and patellar tendon during squatting was also discussed (Djordjevic et al., 2014). However, the relationship between the mechanical properties of lower leg muscles and Achilles tendon in a process of muscle force production is not addressed yet. Therefore, the purpose of this study was to investigate the relation of mechanical property in gastrocnemius muscle and Achilles tendon in plantar flexion in isometric contraction using MC sensor.

Methods

Nineteen males with no physical disabilities on ankle joint were participated in this study. The muscle torque in planter flexion under isometric condition with three ankle joint angles (-20, 0, 20degree) was measured using dynamometer (Biodex co.). The relative value to the peak torque was calculated for all the subjects. The tension of muscle belly (FMC) as an index of mechanical properties of gastrocnemius medialis (GM), gastrocnemius lateralis (GL) was assessed using MC sensor method (TMG-BMC co.). AT the same time, tension of Achilles tendon (Ac) was measured in all the subjects.

Results

FMC of GM and GL in three ankle joints showed a close correlation with the force produced plantar flexion. In -20 and 0 degrees, FMC of Ac showed a high value in increasing the muscle force, whereas it showed almost a stable tension over 40% of MVC at 20 degree.

As far as the relationship between FMC of gastrocnemius muscle and FMC of Ac is concerned, the variance depended on the angles of ankle joint.

Discussion

In this study, tension of gastrocnemius muscle by MC sensor method was linearity correlated to the plantar flexion force. Also, a rate of the tension increase on Ac was not proportional to the set up angles of ankle, rather, it varied in each angle. From these results, it was suggested that tension of Achilles tendon may be affected by the length of gastrocnemius muscle in performing isometric planter flexion.

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Contact

yoko454bsk@yahoo.co.jp

A COMPARISON OF JOINT ANGLES ACCORDING TO DIFFERENCES IN THREE-DIMENSIONAL MOTION ANALYSIS TECHNIQUES

SATO, K., KAORU, K., ATSUSHI, K., RYOICHI, N.
TOHOKU UNIVERSITY

Introduction
Three-dimensional (3D) motion analysis is a technique that allows for objective comparison by quantifying motion. The direct linear transformation (DLT) method, which uses infrared light, has long been widely used for 3D motion analysis. However, the moment tensor (MT) method that uses an accelerometer has been employed more recently. Calculation of joint angles by the conventional DLT method usually involves using a numeric value found by calculating the angles between three reflective markers attached to landmarks on the skin. Nonetheless, if the data of previously reported studies using the conventional DLT method are compared with those obtained using the MT method, the need arises to make comparisons taking into account the characteristics resulting from differences in the calculation methods of each device. The aim of this study is to identify the characteristics of each device by comparing the measurement results of the DLT and MT methods.
Methods
The subjects were 22 healthy young men and women. Cortex3 (Motion analysis, Corp.) was used for DLT 3D motion analyses, while MVN Biomech (X-sens, Corp.) was used for MT analyses. The reflective markers and sensor used in MT were simultaneously affixed to subjects in specified locations and were synchronized after recording by using a trigger signal. Data were also uploaded to C3D format to extract joint angles. Joint angles obtained with MT (MVNX format) were also extracted for comparison. The target motions were three time full squats. The compared joint angles were the sagittal planes of the hip, knee and ankle joints.
Results
A significant difference was seen at $p < 0.001$ in knee flexion angles between the DLT and MT methods (both C3D and MVNX formats). However, no significant difference was seen in the hip or knee joints or between the C3D and MVNX formats with the MT method.
Discussion
The motion analysis technique using the MT method is expected to become more common in the future because it is low-cost and simple to operate and prepare. However, the DLT method has a long history since its introduction as a 3D motion analysis device and has been used and reported in various studies. The presence of differences in angles in the knee joint as observed in this study means that differences may arise in deep motion of joint angles, such as in full squatting, in joints such as the knee with a large range of motion from extension to deep flexion. Because the MT method takes into account the physiological motion of the instantaneous joint center axis, which is inherent to the knee joint, it differs greatly from the DLT method that performs calculations using only the angles between three markers (the center axis does not move). Researchers must therefore use these methods with an understanding of this difference.
Acknowledgments
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SYNERGY OF LEG MUSCLES IN YOUNG AND ELDERLY WOMEN DURING CYCLICAL MOVEMENT

RUTKOWSKA-KUCHARSKA, A., KEBEL, A., WINIARSKA, S.
UNIVERSITY SCHOOL OF PHYSICAL EDUCATION, WROCLAW

Introduction
The changes in movement patterns, that come with age, are the result of changes in the nervous – muscular system. In case of healthy individuals EMG shows, during one movement cycle, the engagement of the same muscles at the same points in time. This pattern disappears in case of nervous system illness or disorders. The aim of the paper was to find lower extremity muscle's synergies, which are necessary to diagnose involution processes of elderly people.
Methods
Two groups of women took part in the research. Young – 23 - 24 years and elderly 60 - 65 years old. EMG and the Kistler platform were used to register and evaluate muscle activity. EMG signals for the follow up muscle groups were registered: gluteus maximus (GS), rector femoris (RF), biceps femoris (BF), tibialis anterior (TA) and gastrocnemius (GA), The following parameters were subject to analysis: relative time of movement, electro-mechanical delay, co-contraction time, co-activation time. In order to establish, which parameter of which muscle is a better differentiator between the young group and the elderly being therefore better at involution process diagnosis, a multifactor analysis of covariance with the discriminatory analysis was done.
Results
During the movement task the younger research participants exhibited longest activation times for BF and TA. For older participants it was TA and GA. For three muscle pairs (RF – BF, RF – TA, BF – TA) the younger participants exhibited longer co–activation times than the older group. On the other hand, the older group showed longer co–activation times for (RF-GA, BF-TA, TA-GA).
Discussion
The gastrocnemius muscles (GA) activation times, achieved in our research align with the existing literature/works. The research done by Brunner & Romkes (2008) show that, the behavior of this muscle is the most sensitive indicator of changes in the gait patterns. In case of the elderly group a shift in activation times has been observed. It may be related to the fact that in case of younger research participants, the sensitivity of GA and RF activation receptors decreases with age, which leads to their later activation (Dietz & Duysens, 2000).
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Contact
alicja.rutkowska-kucharska@awf.wroc.pl

Coaching

A STUDY OF HIGH INTENSITY RUNNING OF SIDE BACK SOCCER PLAYERS DURING GAMES.

SATO, H., KANOH, K., YOSHIMURA, M.
CHUO UNIVERSITY, JUNTENDO UNIVERSITY

Introduction

As the role of the Side Back (SB) player is demanding more and more followed by recent soccer tactics trend, the High Intensity Running (HIR) of the SB player is increasing. Thereby not only the quality but also the quantity due to tactical trend becomes essential for the HIR of the SB player. We consider that significant information can be obtained for coaching thru this HIR analysis. The purpose of this study is to clarify the differences of play levels. We analyzed the HIR of Japanese SB players during games, taking into account the game situation.
Methods
1) Measurement of HIR during games: GPS tracking system (VX SPORTTM, 4Hz)
2) GAME BREAKER Plus was used for game analysis (SPORTS TEC Company)
Data were put on time-line of this software and scenes of different play levels were analyzed. The speed of HIR was set as follows.
Running speed grouping
① Hi-Intensity running & Spring: for running above19.8km/h (HIR and SPT)
② Hi-Intensity running: for running 19.8km/h to 24km/h (HIR)
③ Sprint: for running above 24km/h (SPT)
3) The scene shows the SB player, who starts running from behind the ball, overtakes his teammate to receive the ball. ("Scene A" in this study)
A comparison concerning "the ratio of HIR&SPT", "the timing of acceleration", "maximum speed" of Scene A was carried out.
Subject
1) J-league level: players belonging to J-league 2 players
2) University level : players belonging to Kanto-area universities soccer league 3 players
3) High school level: players belonging to Tokyo Metropolitan league 4 players
Statistical analysis
1) Comparison between categories:
A One-way ANOVA analysis was executed, and Parametric Multiple comparisons, the Turkey-Kramer Method were applied, in cases where significant differences were observed. The results were all presented as mean±SD.$P \leqq 0.05$ was considered statistically significant.
2) As for acceleration timing calculated from game analysis, the relevance was examined based on the Chi-squared test.
Results
From running data, differences in SPT by play level were observed. Especially for the HIR of "Scene A", J-league level players were engaged in SPT more frequently compared with players of other play levels. (J-league level 69%, university level 51%, high school level 27% $P < 0.05$) Also comparing the acceleration timing of Scene A, it became clear that J-league level started acceleration significantly earlier than the other play level ($P < 0.05$). In addition, as for the maximum speed in Scene A, the speed of J-league level was significantly higher than that of the high school level ($P < 0.05$).
Discussion
Followed by recent tactical trend, difference of SPT depending on play level was observed in tactical action, demanded to the SB when attacking. To put tactical action in practical use more frequently, more effectively, it becomes important to take into account physical factors, such as running speed, but also to decide when to accelerate with the flow of the game.

TRADITIONAL CHINESE MEDICINE AND OLYMPIC GAMES

JIANHUA, Y.

NANJING UNIVERSITY OF AERONAUTICS AND ASTRONAUTICS

Introduction
TCM is honored as a national treasure of China, bearing different treatment ideas and methods from Western medicine. In today's medical world where Western medicine takes an absolutely dominant position, TCM was once rejected and misunderstood. However, as one of fruits in five thousand years of Chinese civilization, TCM, with its unique charm, excludes seductive aroma. The Olympic Games, as a sporting event with the largest scale and highest standards in the world, provides TCM with a large international stage to show itself to common people.
Methods
(1)Literature Review Method
(2) Comparative Analysis
(3) Investigation
Results
TCM serves the Olympic Games, specifically through the use of unique TCM treatment principles and methods to help athletes to make good preparation before competition and relax after competition. TCM services to the Olympic Games mainly cover the following 3 aspects. Firstly, unique techniques of TCM can be used to treat sprains and other diseases. Secondly, traditionalacupuncture can be applied to treat various pains. Thirdly, the body-and-mind control method of TCM can be used to help athletes to relieve their anxiety, regulate body and mind, get sound sleep and restore physical fitness.China wants to share TCM with other countries in this world, instead of exclusively owning it. Advantages of western medicine are obvious. Moreover, Western medicine plays a dominant role in countries around the world, including China. However, TCM also has its unique advantages over western medicine. For example, massage in TCM can activate collaterals and excite muscles to relax the local or whole body through traditional techniques. TCM is focused on meridians and acupuncture points, while western medicine places its focus on muscles and joints. Each one has its good points. Before the game, athletes do not dare to take medicine, in consideration of drug test and side effects of drugs. However, the massage is quite safe and effective in warming up before the game, relieving fatigue and treating injuries and illness. 1-hour massage can soothe the soul of athletes and help athletes to ensure the best state for competition.
Discussion
Higher, faster and stronger Olympic Games and the restrained, subtle and low-key Chinese medicine echo with each other. In today's world with an ever-accelerating process of globalization, Chinese and Western cultures should avoid weaknesses and give full play to their strengths, to contribute to the global sports event for a four-year term. TCM has a compelling obligation to make the Olympic Games more brilliant and ensure mental and physical health of athletes.
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DIFFERENCE IN COGNITIVE STRUCTURE OF TEAM TACTICS BETWEEN FEMALE AND MALE FOOTBALL PLAYERS

HASEGAWA, N.
AICHI TOHO UNIVERSITY

Introduction
The importance of tactics in team sports has recently been reported as a major factor for competitions. There are some studies that male football players on the cognition of their team tactics (Koakutsu et al., 2016). The importance of team work along with proper tactics has also been recognized in women's football. Therefore, the aim of this study was to examine future elite female football players on the cognition of their team tactics.
Methods
A total of 169 college female football players who were selected to their regional league responded the survey. The mean age and mean playing experience were 19.82 ± 0.95 years and 11.44 ± 2.83 years. Coaches of each team distributed a set of questionnaire to their player. A total of 44 questionnaires with four-level Likert scale was previously used (Koakutsu., et al 2016a) to ask initial feeling on suggested team tactics.
Results
Exploratory factor analysis (EFA) was conducted. Taken fixed value and interpretable factors into account, four factors are selected. The results showed each variable was related to each factor and showed a simple structure with significant factor loading (> .40). A confirmatory factor analysis (CFA) was run to validate the four factors (14 items) derived from the results of our EFA, and the model derived from (CFA demonstrated a sufficient fit index with the goodness of fit index (GFI) = .908, (AGFI) = .864, (CFI) = .909, and (RMSEA) = .065.
Discussion
The factors are named as the followings. The first factor was "dependency", the second was "solution monitoring", the third was "skill", the fourth was "confusion". And previous study showed that factors were "Mastery", "Importance", "Difficulty" and "Emphasis of the result". The results of this study showed that difference in cognitive structure of team tactics between female and male players. Female football players depend on coaches and tactics. To understand cognitive structures of college female football players could improve coaching efficiency and assist players to more effectively master their team tactics.
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Health and Fitness

THE AVAILABILITY OF STRETCHING EXERCISE WITH NORDIC POLES FOR FALL PREVENTION ON ELDERLY PEOPLE

TABATA, S., FUJITA, T., HIROYAMA, C., SHIBUYA, Y., KOIKE, H., HORISAWA, S., MATSUMOTO, H.
KEIO UNIVERSITY SCHOOL OF MEDICINE

Introduction
Falls are a common and often devastating problem among older people, causing a tremendous amount of morbidity, mortality and use of health care services including premature nursing home admissions (Rubenstein, 2006). The weakening of physical fitness such as balance instability, loss of muscle strength, or reduced flexibility has been known as one of the risk factors of falls in elderly people (Cho et al., 2014; Emilio et al., 2014). Therefore, exercise to improve physical fitness and prevent fall for elderly people is required. The purpose of this study was to investigate the effects of stretching exercise with Nordic poles for fall prevention on elderly people.
Methods
Subjects were 23 Japanese females (age; 71.3±12.5, BMI; 23.3±3.0) regularly participated in a group exercise program for fall prevention. Under the leadership of qualified Nordic walking instructors of Japan Nordic Fitness Association (JNFA), they performed six types of stretching exercise with Nordic poles involving the entire body (trunk, upper limb, and lower limb) twice or three times a month at a community center in Ebetsu city for 16 weeks. They were also required to perform same stretching at home and to keep a daily written record of the number of exercises they performed during the period. Balance function, muscle strength, flexibility and walking ability were evaluated before and at the end of the trial.
Results
Paired sample t test analysis showed statistically significant improvements in balance function (single leg standing time; +21.1 sec, $p<0.05$) and flexibility (sit and reach test; +4.0cm, $p=0.001$) at the end of the trial. On the other hand, muscle strength and walking ability did not show significant improvement. Two subjects dropped out due to exacerbation of pre-existing shoulder or knee pain.
Conclusion
The results suggest that stretching exercise with Nordic poles has a positive effect on balance function and flexibility of elderly people. Stretching exercise with Nordic poles might be efficient for the elderly to prevent falls.
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PREVALENCE OF OVERWEIGHT AND OBESITY IN VOLUNTEERS OF A PRIMARY HEALTH CARE CENTERS IN THE CITY OF GOIANIA/BRAZIL

VIEIRA, C.1, CAMPOS, M.1, GENTIL, P.1, COSTA, G.1, LIRA, C.1, PRADO, E.1, BAPTISTA, T.1
1: FEDERAL UNIVERSITY GOIAS

Introduction
Overweight and obesity are strongly associated with chronic diseases, therefore, to determine the incidence of overweight and obesity in a given population is important for the development of public health policies. The aim of this study was to determine the prevalence of overweight and obesity in volunteers of primary health care centers in the City of Goiania/Brazil.
Methods

Participated in the study 789 patients, 546 women (43.9 ± 16.4 years, 66.2 ± 13.3 kg, 1.6 ± 0.1 m) and 243 men (46.0 ± 17.2 years, 73.7 ± 14.7 kg, 1.7 ± 0.1 m). Body Mass Index (BMI) was calculated by using the Quetelet index. Overweight was defined when the body mass index was between 25.0 to 29.9 kg/m2 and obesity 30.0 kg/m2 or higher.
Results
The analysis of variance indicated no significant difference in IMC distribution between sexes (p = 0.0763). However, there was a significant difference between age groups (p = 0.0000), and a significant interaction between sex and age (p = 0.0196). The percentage of overweight and obesity was above 50% in the population studied, except for young men who had 25.5%. The results show a high prevalence of overweight and obesity among adults and elderly.
Discussion
Data from Vigitel (2013) showed 54.7% of men and 47.4% of Brazilian women were overweight. The values for obesity were around 17.5% for both sexes. Our results approached these values, overweight and obesity was above 50% and the obese percentage is above 15%. Flegal et al. (2012) analyzed the prevalence of adult obesity using the NHANES (2009-2010) and found 35.5% in men and 35.8% in women. In our study the prevalence was 37,4% to women aged between 50 and 59 years and 35,2% to men aged between 40 and 49 years. Gutiérrez-Fisac et al. (2004) have found similar results (80.6% of older women and 80.5% of older men were either overweight or obese) comparing to ours (women and men, 75,9% and 62,9% respectively). The results show a high prevalence of overweight and obesity among adults and elderly. It was also verified a significantly difference between age groups, with BMI increasing with age. These findings make it possible to create effective public policies that can contribute to the control of obesity and reduce the financial impact of these disturbances in public sectors, enabling accessibility and better living conditions for this population.
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PEAK TORQUE AND TOTAL WORK RECOVERY FOLLOWING BENCH PRESS TRAINING IN TRAINED MEN

GENTIL, P., FERREIRA, D.V., FERREIRA-JUNIOR, J.B., SOARES, S.R.S., BROWN, L.E., BOTTARO, M.
UNIVERSIDADE FEDERAL DE GOIAS

Introduction
Maximal voluntary contractions, such as isokinetic peak torque (PT) tests, are widely used for tracking muscle recovery; however, these tests may not reflect the ability of performing longer tasks, such as multiple repetitions, which can lead the repetition of a training session sooner than recommended and result in an imbalance between stress and recovery. Therefore, the purpose of the present study was to compare recovery of PT, total work (TW), and subjective perception of physical fitness (SPPF) following a bench press resistance training session.
Methods
Twenty-six resistance-trained men (23.7±3.7years; 176.0±5.7cm; 79.6±7.6kg) performed eight sets of the bench press exercise to momentary muscle failure. Shoulder horizontal adductors PT, TW and SPPF were measured pre, immediately post, 24, 48, 72 and 96 h following exercise.
Results
Immediately after exercise, the reduction in TW (25%) was greater than PT (17%). TW, as a percentage of baseline values, was also less than PT at 24, 48 and 96 h after exercise. PT returned to baseline at 96 h, while TW did not.
Discussion
SPPF did not reflect recovery of muscle performance, which is similar to previous studies 4. PT recovered sooner than TW, suggesting a dissociation between maximal strength recovery and the capacity to perform multiple repetitions. One possible explanation is the reduced glycogen content associated to muscle damage2, which can result in a greater impairment in longer than in short duration tasks. If this is the case, the negative effects in a training session with multiple sets of multiple repetitions may be even more pronounced. Therefore, considering the negative effects of the frequent repetition of stimuli without adequate rest 1,3, one should be cautious when calculating recovery based on PT values.
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TRAINING EFFCT DURING THE MIDNIGHTSUN PERIOD IN DIFFERENT CHRONOTYPES

WEYDAHL, A.
UIT- ARCTIC UNIVERSITY OF NORWAY

Introduction
Earlier we found that adults with different chronotypes responded differently to exercise performed in day-light or darkness (Rossi, Calogiuri, Formenti, Vitale, & Weydahl, 2013). During the polar night, when the sun is not above the horizon, evening (E) and neither (N) -types respond to training better than morning (M) -types (paper submitted). At 70N, the sun is above the horizon for 8 weeks, midnight sun. This study reports the effect of training during the midnight sun period in individuals with different chronotypes.
Methods
Using Horne and Östberg questionnaire 10 M-, 10 N- and 10 E-types were chosen to participate. Their VO2max, strength, balance and flexibility were tested before and after training through the midnight sun. The participants trained in a group one hour out-of-doors and one hour indoors each week in addition to every-day homework, like going outside at least 10 minutes, some flexibility, balance and strength exercise. They got a training program to follow for the vacation- period. The participants recorded their training in a training log, and were supposed to use a Polar team2 ® heart rate recorder, when they were training.
Results
Only 2E-, 5N- and 6M-types showed up for testing in the beginning of the midnight sun period (May). After the midnight sun period (August) 2E-, 3N- and 6 M-types showed up. All participants except one E-type, showed a decrease in VO2max from May to August. This participant increased the VO2max to 51ml/min x kg from 38 ml/min x kg. We suspect that the result in May is too low, or that the result in August is wrong. If we exclude this person from the study, we have only 1 E-type, 3 N-types and 6 M-types. It seems as if it is difficult to

keep the E-types as participants in the study. The training logs showed that the participants had been active, but not in the organized training activity. The heart rate recordings were insufficient.
Discussion
Participating in organized training seems to be hard during the midnight sun period. Continuous follow-up and motivation is necessary to keep subjects in a study were training is required. Especially E-types seem to need special follow-up. Even if the participants claimed they were active during the 10-week training period, we could not observe any positive training effect. It seems that the participants have more choices for activity like hikes, fishing and other out-of-doors activity. These activities might not have the intensity required to increase physical fitness, no matter what chronotype the subject belongs to. During the midnight sun period, the biggest challenge is to get people to choose activities that give high enough intensity to get a training benefit. The group size is a limiting factor.
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IMPACT OF THE HIGH PHYSICAL LOAD EXERCISES ON HEALTH STATUS OF MILITARY PERSONNEL

PLAVINA, L.

NATIONAL DEFENCE ACADEMY OF LATVIA

Introduction
Military personnel are in high risk group for heath disorders, musculoskeletal pathology and psychological overload (Aandstad, 2014; Berry et al., 2017; Feuerstein et al., 1997; Mikkola et al., 2012; Lystrup et al., 2015).We provided evaluation of the anthropometric parameters and health status of military personnel, who have participated in ten days duration Combat training course with feeding limitation, sleeping deprivation intensive and continuous training, strict discipline Such situation requires adaptation to novel way of activity, which include hardship and arduous training. Combat training course is a unique military environment designed to rapidly physical, cognitive, social changes in participants (Lieberman et al., 2008; Taanila et al., 2010; Lindner et al., 2012). The purpose of the study is to reveal impact of ten days long combat training course (CTC) with high physical load exercises in extreme conditions to the anthropometric parameters and health status of participants
Methods
We provide evaluation the anthropometric characteristics of participants of the Combat training course that includes 49 military persons of both genders (included 41 males and 8 females) in age 22-30 years. We provide body mass registration at the beginning, at the middle and at the end of ten days long Combat training course. We provided analysis of basic anthropometric measurements: body mass, body height. Body mass index was calculated by dividing body mass (kilograms) by the square of height (meters). We assessed data of standardized Nordic Questionnaire for Analysis Musculoskeletal Symptoms in the study group before combat training course.
Results
Body mass index value for early adulthood in male group for 50% respondents and for 100% respondents in female group is corresponded to the standard body mass index value (norm) data (till 24.9). Body mass value deceased about two- three kg for half of respondents (50.9%) for 18.3 % of participants on combat training course body mass value changes were small; they diminished in interval of one kg; there were 12.2% participants for whom changes of body mass value were about six kg. Analysis musculoskeletal symptoms cadets indicated main problematic regions, which are the lower back (48.9%), upper back (23.4%), then the neck region (25.5 %) and the foot region (25.5%). Analysis of health problems for participants after Combat training course (revealed such problems as acute respiratory infections (35.2%), foots` dermatological problems (35.2 %), and symptoms of the musculoskeletal disorders (29.4%), the gastrointestinal problems (5.8 %).
Discussion
Combat training course with transition from daily military training routine to military exercise in external environment revealed changes of body mass and health state.

AMETROPIA/VISUAL DEFICITS IN COMPETITIVE SPORTS – AN UP-TO-DATE STOCK TAKING

JENDRUSCH, G., OERTZEN-HAGEMANN, V., BUßMANN, C., PLATEN, P.

RUHR-UNIVERSITÄT BOCHUM

Introduction
Former investigations showed that about 20% of all elite athletes who have been examined in the context of visual performance diagnostics exert their sport ametropic/with visual deficits (Jendrusch, 2008), although it is known that considerable visual reductions are leading to uncoordinated movement, even if motion sequences are automized. Nevertheless regular and meaningful visual tests for the analysis of the multidimensional visual performance and the detection of ametropia are only integrated in the health or performance diagnostics of few sports. Aim of the present study was to analyze current data of German elite athletes concerning ametropia or different parameters of visual performance; especially considering parameters that are also tested by optometrists or ophthalmologists.
Methods
The Vision Test Battery includes visual parameters like visual acuity, refraction error (nearsightedness/myopia or astigmatism), contrast sensitivity, stereoscopic perception of depth and color perception. The study focusses on a retrospective analysis of cross-sectional eye test data from different German national teams or first division athletes (n=553; age: 21.0±4.0 years) which were collected in the annual routine health check during the last three years (2013-2015).
Results
About 27.5% of athletes use glasses or contact lenses in their daily life. 33.3% of athletes (women=29.3%; men=37.7%) with ametropia are practicing their sports without an optical correction. On one hand, there was a lack of awareness about the effect of visual performance on sporting performance, on the other hand the correction used was unsuitable to go in for sports or correction was poor in relation to wearing comfort. The median of the (monocular) visual acuity is about 1.85 for men and 1.80 for women (with maximum-values considerably above 2.50). Altogether 22.6% of athletes (women=21.8%; men=23.0%) are detected as ametropic and thus in need of correction. 7.0% of the athletes tested (women=4.3%; men=8.8%) had deficits in depth perception; 7.5% of the men showed a color asthenopia (red-green).
Discussion
Vision has a crucial importance for movement control and balance regulation. Vision promotes anticipation, e.g. fast movements in ball games as well as potential accident risks e.g. in one-on-one-situations in football. The rate of ametropia is still high and shows that

regular eyesight tests are necessary in competitive sports and should be an inherent part in health diagnostics in order to be able to detect and – subsequently – correct visual deficiencies at an early stage.
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BONE MINERAL DENSITY IN PREPUBERTAL RHYTHMIC GYMNASTS ENTERING PUBERTY: ASSOCIATIONS WITH JUMPING PERFORMANCE AND BODY COMPOSITION PARAMETERS

JÜRIMÄE, J., VÕSOBERG, K., TAMM, A.L., TILLMANN, V.
UNIVERSITY OF TARTU

Introduction
This study examined bone mineral density (BMD) accrual in prepubertal rhythmic gymnasts entering puberty and their age-matched untrained controls, and associations with baseline jumping performance and body composition over the 3-year period.
Methods
Whole body (WB) and femoral neck (FN) BMD, WB fat mass (FM) and fat free mass (FFM), countermovement jump (CMJ) and rebound jumps for 15 s (RJ15s) were measured in 25 rhythmic gymnasts and 25 untrained controls at baseline and after 3-year period. The change over this period was calculated (Δ score).
Results and Discussion
The pubertal development over the 3-year period was slower in rhythmic gymnasts compared to untrained controls, while no difference in bone age development was seen. Whole body BMD increased similarly in both groups, while the increase in FN BMD was higher in rhythmic gymnasts compared with untrained controls. In rhythmic gymnasts, baseline FFM was the most significant predictor of ΔWB BMD explaining 19.2% of the variability in ΔWB BMD, while baseline RJ15s was the most significant predictor of ΔFN BMD explaining 18.5% of the variability in ΔFN BMD. In untrained controls, baseline FM explained 51.8 and 18.9% of the variability in ΔWB BMD and ΔFN BMD, respectively. In conclusion, while the WB BMD accrual over 3-year period was similar in both groups, continuous high-impact mechanical loading had additional beneficial effects on the FN BMD accrual in prepubertal rhyhmic gymnasts entering puberty. Jumping performance and FFM values predicted BMD accrual only in girls with previous athletic activity, while FM was associated with BMD accrual in prepubertal untrained control girls entering puberty. Finally, only repeated jumps test (RJ15s), but not single jump test (CMJ) characterized bone development in rhythmic gymnasts.

RELATIONSHIP BETWEEN INDEFINITE COMPLAINTS AND WEIGHT CONTROL IN EAST ASIAN FEMALE UNIVERSITY STUDENTS

IKEDA, T.1, IKEDA, T.A.2, YAITA, A.3, SAKAGUCHI, H.4, ITO, H.5, AOYAGI, O.5, HONG, Y.6, HAN, N.6, CHOI, T.6, NAM, Y.7, KOO, K.8
1 NISHI-KYUSHU UNIV., 2 FUKUOKA PREFECTURAL UNIV., 3 KYUSHU-KYORITSU UNIV., 4 JAPAN UNIV. OF ECONOMICS, 5 FUKUOKA UNIV., 6 JEJU NATIONAL UNIV., 7 DUKSUNG WOMEN'S UNIV., 8 CHANGWON NATIONAL UNIV.

Introduction
Indefinite complaints (ICs) have been identified as a problem in Japanese females (Furuta et al., 1998). Young females tend to strongly desire having a slender body, and therefore engage in weight control (WC). However, many WC methods used by young females in Japan are unhealthy (Ikeda & Ikeda, 2004; Ikeda et al., 2005). WC has also been shown to cause mental and physical health problems in South Korea (Woo, 2014). Therefore, the purpose of the present study was to investigate the relationship between ICs and WC in Japanese and South Korean university students.
Methods
The participants were 823 university students who had to some extent engaged in WC (Japanese males: 81, females: 264; Korean males: 186, females: 289). All participants were rated on the Scale of Diet Behavior (SDB) (Matsumoto et al., 1997) and surveyed on 33 items regarding ICs (Furuta et al., 1998). The IC items were analyzed using factor analysis, and the relationships between sex, nationality, WC, and various IC factors were investigated using multiple regression analysis (MRA).
Results
The SDB results revealed two factors, structured diet (SD) and unstructured diet (UD), and the IC revealed the following six factors: fatigue (F), digestive system (D), autonomic nervous system (A), respiratory system (R), skin (S), and motor system (M). The MRA results showed that some IC factor scores (beta: F = –.139, A = –.134, S = –.168, M = –.133) were higher for Korean than for Japanese university students. Regarding sex, most IC factor scores (F = –.163, D = –.098, A = –.142, S = –.177, M = –.184) were higher for females than for males. Regarding WC, a significant relationship was observed between UD and all IC factors, and most IC factor scores (F = .086, D = .232, A = .273, R = .355, S = .163, M = .142) were higher for students on a UD than for students on an SD.
Discussion
Although the problem of ICs is common in both Japan and Korea, it appears to be more prevalent in South Korean university students. Furthermore, students engaging in UD show high ICs regardless of nationality. The results of the present study suggest the importance of health education regarding appropriate WC methods for young East Asian females.
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SURVEY OF MENTAL AND PHYSICAL STRESS IN BUSINESSPEOPLE USING SALIVA AMYLASE AND VAS

NAKAJIMA, S.
KYORITSU WOMEN'S JUNIOR COLLEGE

Introduction
The accumulation of workers' stress and chronic fatigue causes both physical and mental disorders, which are significant health problems. In fact, it is reported that about 60 percent of people feel 'strong anxiety, trouble, stress'. On the other hand, exercise is known to be

effective, not only for prevention of lifestyle diseases, but also for relieving stress and reducing fatigue. In this survey, the researcher subjectively evaluated fatigue among businesspeople, the presence of mental and physical stress, and objectively investigated using physiological indicators.
Methods
The subjects were businesspeople who lived or worked in the C zone in Tokyo. For the following items, measurements were carried out continuously over a seven-day period.
1) In order to evaluate objective stress, measurement was conducted using a salivary amylase monitor (Nipro). Measurements were taken immediately after the subject go up, and three, six, nine, and twelve hours after waking up, and six times a day before the subject went to bed. The subject carried the measuring instrument on his / her own measurement.
2) In order to evaluate subjective fatigue, the subject checked the recording paper at the time of measurement as outlined above. The Visual Analogue Scale (VAS) used a scale in which 0 represented no feeling of fatigue at all and 10 represented a feeling of exhaustion.
Results and Discussion
Measured values of saliva amylase showed high values on work days immediately after getting up and three hours after getting up relative to the measured values on holidays. When comparing measured values of saliva amylase on a daily work day and a work day on a holiday, the measured value immediately after getting up for a regular work day showed a high value. Immediately after getting up, VAS showed the same level on both work days and holidays, but it showed a remarkably high value on the work day compared with the number on holidays as time passed from waking up to bedtime.

STUDY ON THE PHYSICAL FITNESS OF FRESHMEN IN NANJING UNIVERSITY OF AERONAUTICS AND ASTRONAUTICS IN THE 2016 SCHOOL YEAR

YUJUN, L.
NANJING UNIVERSITY OF AERONAUTICS AND ASTRONAUTICS

Introduction
This study was designed to analyze the physical fitness of the current situation of Nanjing University of Aeronautics and Astronautics's 2016 school year newborn , the actual detection of a total of 4683 students, including 2946 males,1737 females. To understand the physical fitness of students and as a conduct of PE class.
Methods
According to the "National Student Physical Health Standard Line testing", the project includes body mass index（BMI）, Standing long jump, sitting body flexion, one minute knees supine(Girls), pull-ups (boys), and running (girls:800 meters, boys: 1000 meters). All data were analyzed by descriptive statisticsAnalysis.
Results
First, there were no differences in body composition between the male and female students in healthy subjects. Second, boys in softness, muscle (resistance) and cardiopulmonary endurance are poor. Third, girls only in the instantaneous force is lower than the standard value.
Discussion
In the teaching of physical education in the future, it is possible to strengthen the sports training for the difference of the students 'physical abilities, so as to improve the students' physical fitness.
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EFFECTS OF QIGONG EXERCISE ON COGNITIVE FUNCTION AND CARDIOVASCULAR FITNESS IN HEALTHY MIDDLE-AGED SUBJECTS

LADAWAN, S., KLAROD, K., PHILIPPE, M., MENZ, V., VERSEN, I., GATTERER, H., BURTSCHER, M.
UNIVERSITY OF INNSBRUCK

Introduction
Qigong exercise is one of mind-body exercises which is believed to evoke positive effects such as improved cognition, reduced stress and anxiety. Previous literature suggested that cognitive ability is associated with cardiovascular fitness (Voelcker-Rehage et al.,2010). Therefore, the purpose of the present study was to investigate effects of Qigong exercise on cognitive function and cardiovascular fitness in healthy middle-aged subjects.
Methods
Study part 1 examined the effects of Qigong exercise in 12 subjects (5 males, 7 females, aged 52.2±7.1 years) who performed Qigong exercises 3 days a week for 8 weeks. Study part 2 evaluated the detraining effects 12 weeks after cessation of Qigong. Cognitive function (Digit Span Forward and Backward Test, Trail Making Tests part A and B), and cardiovascular fitness (VO2max and maximal workload) were determined at baseline, immediately after the training program, and after the detraining period.
Results
Qigong training showed a significant improvement of Trail Making Tests part A ($p = 0.04$), and maximal workload ($p = 0.03$). Twelve weeks after cessation, Trail Making Tests part A and maximal workload had returned to baseline ($p = 0.05$, and 0.02, compared to immediately after the training, respectively). Baseline Digit Span Forward score was correlated with both maximal workload at baseline ($r=0.07$, $p=0.01$) and immediately after training ($r=0.61$, $p=0.04$).
Discussion
After eight weeks of Qigong training, time to complete TMT-A decreased significantly with a subsequent increase after cessation of training which is in line with previous studies demonstrating improvements in TMT-A after exercise training (Chin et al., 2015). This may relate to the fact that Qigong is characterized by gentle movements coordinated with breathing, done in a concentrated way, facilitating conscious control of each body movement. Maximal workload significantly increased after Qigong training whereas VO2max did not. It is suggested that Qigong exercise has a preferentially positive effect on muscular strength. Correlation of Digit Span Forward with both

maximal workload at baseline and after training is also consistent with previous a study suggesting that cognitive function is associated with cardiovascular fitness and muscular strength (Voelcker-Rehage et al.,2010).
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CONSTRUCTION OF BODY FATNESS TRACKING EVALUATION CHART UNDER EARTHQUAKE ENVIRONMENT

WATANABE, T.1, FUJII, K.2

1:THE UNIVERSITY OF AIZU (FUKUSHIMA, JAPAN), 2:AIT : GRADUATE SCHOOL OF BUSINESS ADMINISTRATION AND COMPUTER SCIENCE, AICHI INSTITUTE OF TECHNOLOGY (TOYOTA, JAPAN)

Introduction
In this study, taking advantage of the efficacy of the wavelet interpolation model, we first applied wavelet interpolation to the averaged growth distance values for physique and motor fitness in elementary school children based on the Physical Strength and Motor Fitness Survey Report issued by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). Next, wavelet interpolation was applied to the values of ±0.5 SD and ±1.5 SD of the national mean growth distance value, and an evaluation chart was constructed. Then the longitudinal physique development values obtained in this study were applied to the obtained national mean evaluation chart, and the resulting evaluation was investigated and the validity of the derived evaluation system for elementary school children was examined. For the tracking of physique and body fatness, the values were applied to the longitudinal evaluation system for the physical development process derived in this study for the level of individual longitudinal physique development data at each age. By confirming those judgments, the tracking status with age-related changes in physique and body fatness were verified.
Methods
The subjects were 188 boys and girls in multiple elementary schools in Fukushima Prefecture. The survey and measurements were explained in advance to the subjects' parents, and their informed consent was obtained. None of the subjects had any acute or chronic diseases. The precise age of the subjects at the time of measurements was calculated using their dates of birth to compose an age axis at the time of first grade in elementary school.
Results
Looking at the tracking of 15 children judged to be obese and the 7 children judged to be slim from the tracking analysis diagram of the 188 children, it is seen that nearly all of these children tracked within the obese and slim evaluation bands.
Discussion
Wavelet interpolation was applied to the mean growth and development distance values for physique and motor fitness of first to sixth grade elementary school children issued by MEXT. This is because longitudinal evaluation is possible with smooth interpolation of the statistics showing growth and development in physique and motor fitness, and can lead to the establishment of a rigorous evaluation chart. In this way, a uniform method to evaluate longitudinal data is assured. This study was able to investigate that tracking status by uniformly evaluating longitudinal data on physique from the first to sixth grades of elementary school.
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Contact
twatanab@jc.u-aizu.ac.jp

EFFECT OF SHORT-TERM LOW-INTENSITY STRENGTH EXERCISE WITH SKIN COOLING OVER WORKING MUSCLE ON NEUROMUSCULAR FUNCTION AND PHYSICAL FITNESS IN ELDERLY WOMEN

NAITO, Y.1, YONA, M.2, SHIMOSE, R.3, SUGAWARA, H.4, TADANO, C.5, SEKI, H.6, SAKAMOTO, M.7, MURO, M.5

1: KOKUSHIKAN UNIV. (JAPAN), 2: TUPLS (JAPAN), 3: SAGAMIHARA-CHUO HOSPITAL (JAPAN), 4: TUT (JAPAN), 5: TOHO UNIV. MED. (JAPAN) 6: NUM, 7: KITASATO UNIV. (JAPAN)

Introduction
Weakness of the leg muscles manifested by a decrease in force-generating capacity has profound functional consequences resulting in limitations in daily life activity and an increased risk of falls. The stimulation of skin cold receptors over working muscle induces high threshold motor unit recruitment during sub-maximal voluntary contraction. Shimose et al. reported that skin cooling with a small decrease in muscle temperature over agonist muscles increased EMG activity and improved rate of force development (RFD), due to the effects of an altered neural drive. In this study, we investigated the effect of short-term low-intensity strength exercise training with skin cooling over agonist muscles on muscular strength (MVC), neural drive (RFD), and physical fitness, in elderly women.
Methods
Seven healthy elderly women [age 72.0(5.0), BMI 24.4(1.8)], without regular exercise training experience, completed supervised strength training with skin cooling, and five women [age 60.8(8.5), BMI 22.7(0.6)] performed the same training without cooling as a control. The exercise was performed once a week and lasted for 6 weeks. After a 10-min warm-up session, the subjects performed strength training which consisted of two sets of twenty-five repeated knee flexion exercises (3s action, 3s interval) using a Thera-band®, followed by 10-min aerobic exercise and a cool-down exercise. The subjects were able to choose the intensity of strength training with the Thera-band® themselves. During knee flexion exercise, skin cooling was applied over the hamstring muscles by circulating 5-degree water through cooling-pads (Japan Sigmax Co.). The mean skin temperature was maintained at 25-26 degrees during strength training. Before and after the training period, physical fitness tests including handgrip strength, leg extensor power, single-leg balance with eyes closed, and the timed up go test (TUGT), were measured. Rate of isometric force development (RFD) was calculated as the first derivative of force development at 50, 100, and 200 ms.
Results and Discussion
Exercise training with skin cooling stimulation caused significant increases in handgrip force and leg extensor strength, whereas no significant changes were seen in the control. There were no changes in RFD at 0-50 ms in both groups. However, RFD at 0-100 ms, and 0-200 ms were significantly larger in the skin cooling group after training. TUGT time was better in both groups after training. The results suggest that low-intensity resistance exercise training with skin cooling over working muscles was effective at increasing muscular strength and improving neural drive, therefore it could be a useful method for promoting neuromuscular function covering a wide range of the population, including the frail and elderly.
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EFFECT OF 1-YEAR YOGA ON ADIPOKINE PROFILE IN CHINESE ADULTS WITH HIGH-NORMAL BLOOD PRESSURE AND METABOLIC SYNDROME

SUPRIYA, R., ANGUS, P., YU, C.W., LAI, L.W., CHAN, B.Y., YUNG, P.H., PARCO, M.S.

THE HONG KONG POLYTECHNIC UNIVERSITY

Introduction
Medical experts have identified metabolic syndrome (MetS) as a pre-diabetic state. Hatha yoga exercise has been shown to improve the cardiovascular risk factors including central obesity and blood pressure (BP) in middle-aged and older adults with MetS1. This study followed up the effect of 1-year yoga training on adipokines including adiponectin, leptin, chemerin, visfatin and PAI-1 in Hong Kong Chinese adults with high normal blood pressure and MetS.
Methods
99 Hong Kong Chinese adults with high normal blood pressure and MetS according to the guideline of the United States National Cholesterol Education Program (NCEP) Expert Panel Adult Treatment Panel (ATP) III, aged 50 to 92 were categorized into 2 groups (Control Group n = 46, Yoga Group n = 53) . Subjects in yoga group underwent a yoga training program with three yoga sessions weekly for 1 year. Each session lasted for 60-min consisting of 10-min of warm-up, 40-min of Hatha yoga practice, and 10-min of breathing exercise and relaxation. In addition to cardiometabolic risk factors (i.e., systolic and diastolic blood pressure, fasting blood glucose, triglycerides, and high-density lipoprotein cholesterol) of MetS, five adipokines including adiponectin, leptin, visfatin, chemerin and PAI-1 were assessed in the blood samples.
Results
We found that there was a trend of reduction in waist size (yoga x time effect P=0.054) after 1-year yoga. We also found decreases in leptin, chemerin and PAI-1, (yoga x time effect P<0.01) and increase in adiponectin (yoga x time effect P<0.01) in the yoga group as compared to the control group.
Discussion
Our result demonstrated that 1-year hatha yoga training reduces waist size in subjects with high normal blood pressure and MetS may be by affecting the levels of visceral (chemerin, PAI-1) and subcutaneous (adiponectin and leptin) adipokines or vice versa in middle-aged and older adults with MetS. Adiponectin, leptin, chemerin and PAI-1 were found to be correlated with the risk factors of MetS2. Therefore, our findings support the complementary beneficial role of yoga in managing MetS by modulating the circulatory levels of adipokines.
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OBESTATIN BUT NOT GHRELIN REVEALS THE DISTINCTIVE INTERACTION OF CENTRAL OBESITY WITH OTHER METABOLIC SYNDROME RISK FACTORS

UGWU, F.N.1, YU, A.P.1, TAM, B.T.1, MA, V.1, CHOW, A.S.1, LAI, W.C.1, LEE, P.H.2, SIU, P.M.

THE HONG KONG POLYTECHNIC UNIVERSITY

Introduction
Central obesity is commonly considered as a key component of metabolic syndrome (MetS), which is a cluster of syndrome for insulin resistance, hyperglycemia, dyslipidemia, hypertension and central obesity that increase the risk of diabetes mellitus and cardiovascular diseases. This study was designed to examine the influence of the interaction of central obesity with the other MetS risk factors including blood pressure, waist circumference, fasting blood glucose, triglycerides, and high-density lipoprotein cholesterol (HDL-C) on circulatory ghrelin gene products including unacylated ghrelin (UnAG), acylated ghrelin (AG) and obestatin.
Methods
Hong Kong Chinese adults (n = 133; mean ± SD age = 61 ± 9 years) with specific MetS risk factors were classified according to the National Cholesterol Education Program-Third Adult Treatment Panel (NCEP ATP III) criteria into four groups: no MetS risk factor (ie elevated blood pressure, triglycerides and fasting blood glucose and low HDL-C) no central obesity (NRFNO), no MetS risk factor save central obesity (NRFO), all MetS risk factors save central obesity (RFNO) or all MetS risk factors plus central obesity (RFO) group. Systolic blood pressure, diastolic blood pressure, waist circumference, fasting blood glucose, triglycerides, high-density lipoprotein cholesterol, UnAG, AG and obestatin were assessed. To investigate the interaction of central obesity and other MetS risk factors, the Aligned Rank Transform procedure was conducted, followed by two-way analysis of variance (ANOVA) in SPSS. Statistical differences among the four groups were determined by Kruskal-Wallis H Test, followed by post hoc tests. Statistical significance was accepted at $p < 0.05$.
Results
According to our two-way ANOVA, obestatin revealed the interaction of central obesity with the other MetS risk factors. In addition, Kruskal-Wallis H Test showed a significant difference in obestatin among the four groups under study. Further analyses showed significant differences between NRFNO and RFNO, NRFNO and RFO, NRFO and RFO and between RFNO and RFO groups. UnAG and AG did not reflect the interaction of central obesity with the other MetS risk factors. However, Kruskal-Wallis H Test showed a significant difference in UnAG and AG among NRFNO, NRFO, RFNO and RFO groups. Post hoc analyses showed significant differences in UnAG and AG between NRFNO and RFNO, NRFNO and RFO and between NRFO and RFO groups.
Discussion
Our study provides evidence in support of central obesity as a main risk factor of MetS. Although the pathophysiological mechanisms that link central obesity to the other MetS risk factors are not completely understood, our data suggest that the interaction of central obesity and the other MetS risk factors may be critical in the genesis of MetS. In conclusion, ghrelin gene products may serve as potential targets for further understanding the risk factors of MetS and subsequent diseases.
Contact
felix.ugwu@connect.polyu.hk

EFFECTS OF DANCE EXERGAMING ON WEIGHT CONTROL AND THE MARKERS OF METABOLIC SYNDROME IN OVER-WEIGHT AND OBESE ADULTS

CHANG, W.H., CAI, Z.Y., CHENG, Z.Y., CHANG, C.H., LAI, Y.A., WU, P.H.
KAOHSIUNG MEDICAL UNIVERSITY & NATIONAL SUN YAT-SEN UNIVERSITY

Introduction
The epidemic nature of obesity in industrialized countries is a serious health and social concern. It is also associated with multiple medical problems such as metabolic syndrome, CVD and type 2 diabetes [1]. Exergaming, which integrate exercise and gaming entertainment, might be considered as a strategic tool in the fight against childhood obesity [2]. Therefore, the aim of this study was to evaluate the effects of dance exergaming (Just Dance 4) on body composition and the biomarkers of metabolic syndrome in overweight or obese adults.
Methods
A total of 34 overweight (BMI > 24) or obese (BMI > 27) subjects were randomly assigned to a XBOX group asking to play dance exergaming (Just Dance 4, engage in at least 150 minutes per week), or a Control group asking to maintain their normal life behavior. Anthropometric measurements (body weight, BMI, body fat, waist and hip circumference), blood pressure, and blood chemistry analysis (blood sugar and lipid profiles) were performed at baseline, at 4wk and 8wk follow-up.
Results
All dance exergames were moderate intensity activities (range from 3.72 ± 0.82 to 4.75 ± 1.13 metabolic equivalents; METs). Compared to baseline, there were significant decreases in weight (72.8 ± 12.6 vs. 71.2 ± 12.8 kg), BMI (26.6 ± 2.5 vs. 26.0 ± 2.6 kg/m2), body fat (30.0 ± 6.9 vs. 29.4 ± 6.6 %), waist circumference (84.4 ± 9.4 vs. 80.2 ± 10.5 cm), hip circumference (103.1 ± 4.3 vs. 99.2 ± 4.8 cm), and blood pressure at the 8-wk follow up in XBOX group. Only serum LDL-C level (115.2 ± 30.0 vs. 100.1 ± 23.0 mg/dL) significantly decreased in the XBOX group. No significant changes in any anthropometric and blood markers were found in Control group.
Discussion
Results from previous studies have demonstrated that higher energy expenditure can be substantially increased when playing exergames compared to non-active gaming and other sedentary screen activities such as watching television. Exergaming can generally elicit light to moderate intensity physical activity (2–6 METS) [3]. In addition, exergaming was rated as significantly more enjoyable than sedentary video gaming, treadmill walking, or previous engagement in generic PA [4]. It is noteworthy that our study reported a 95% compliance rate after 8 weeks, emphasizing the potential of exergaming to motivate overweight or obesity individuals to engage in PA more regularly. Therefore, exergaming may be an effective technological tool for increasing physical activity, promoting weight loss and decreasing the incidence of metabolic syndrome in sedentary people.
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Contact
hedy@kmu.edu.tw (Chang WH)

REPRESENTATIONS ABOUT PHYSICAL ACTIVITY AMONG FIREFIGHTERS. A STUDY IN WALLONIE.

DUBRU, G., GRIBOMONT, A., CLOES, M.
UNIVERSITY OF LIEGE

Introduction
To be a firefighter is a dangerous job. Many authors have found anxiety, stress, depression, sleep disorders, absenteeism and other deviant behaviors in this type of high-risk occupation (Fullerton, Ursano & Wang, 2004 ; Carey, Al-Zaiti, Dean, Sessanna & Finnell, 2011 ; Elliot & Kuehl, 2007). Adopting an active lifestyle is therefore very important in reducing these health risks and thus maximizing the chances of staying healthy. It is for this reason that physical activity has an essential role for these people. According to this determining the place occupied by physical activity within the regional Walloon fire servicesseemed relevant. The first step should be to analyse the firefighters' representations and lifestyle.
Methods
An online questionnaire (SurveyMonkey) was developed. It proposed a majority of closed-ended questions facing on age (38 ± 10.4 years), BMI (26.1 ± 3.7), gender (96.7% of men), rank, status (38.3% professional), PA representations and practices, well-being and self-esteem, job satisfaction, … We contacted one of the main firefighters association (FRCSPB) to reach a significant number of topics. 443 questionnaires were collected during a five weeks period. 394 were usable. 376 responses were needed to achieve a 95% confidence level with a 5% confidence interval based on all Belgian Firefighter.
Results and discussion
Results showed that firefighter showed positive representations about PA and were aware of the benefits of a regular practice on their health. Good stress management and cardiovascular endurance qualities were considerate as important in this profession. Nevertheless, subjects deplored a lack of maintenance of these qualities. The mean BMI of the subjects was above 26, indicating a slight overweight. Sedentary lifestyle, poor infrastructure, injuries due to lack of fitness allow us to suspect an insufficient training. Other factors were pointed out by the subjects (stress, absenteeism, deviant behavior…). Firefighters were generally satisfied with their job and considered that they have an acceptable quality of life. However lack of time, financial and human resources must not be a barrier to the practice of essential PA for those people who are directly related with danger.
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DIFFERENCE IN PHYSIOLOGICAL RESPONSES ON MUSCLE ACTIVITY AND OXYGEN UPTAKE BY TWO KINDS OF NORDIC WALKING IN COMMUNITY-DWELLING MIDDLE-AGED AND OLDER ADULTS

FUJITA, E.1, TAKEDA, M.2, ISLAM, M.M.1, TAKESHIMA, N.1

1: NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA, 2: DOSHISHA UNIVERSITY

Introduction
Nordic walking (NW) is an outdoor activity using specially designed poles for the purpose of activating the upper body while walking. The poles are used to push against the ground with each stride. In general, the poles are used to push against the ground towards the back of the body. This style is called as the diagonal technique (DIA). On the other hand, a walking method of using the poles forward like a cane was devised and disseminated in Japan as a method of rehabilitation for physically frail older adults and patients with walking difficulty (Matsuoka et al., 2010). This walking style is so called as Japanese-style Nordic walking (JS). DIA is characterized by higher muscle activity (Je-myng et al., 2013), and increased energy consumption when compared to ordinary walking (Sugiyama et al., 2013). However, only a few studies are available to compare DIA and JS. This study aims to investigate muscle activity and oxygen uptake during both NW so as to clarify differences between the two NW styles.
Methods
The subjects were 12 community-dwelling middle-aged and older adults (mean age: 62.4 ± 7.8 years) who experienced in DIA and JS, two times a week for 9 weeks intervention. All of subjects were tested to perform NW in both DIA and JS for 12 minutes walking with their maximum effort around the park. Walking distance, heart rate (HR), and oxygen uptake (METs) were measured during both walking. Surface electromyograms were recorded from the right upper and left lower limbs. In addition, force applied to the right pole, which was equipped with a compression-type load cell, was recorded during DIA and JS.
Results
Mean NW distances in DIA (1,094 ± 88 m) was significantly higher than JS (1,078 ± 63 m). There were no significant differences in HR between DIA (128 ± 19 bpm) and JS (127 ± 20 bpm), respectively. Significant difference in muscle activity was observed between DIA and JS in the triceps brachii only (DIA: 19 ± 11 %EMGmax, JS: 13 ± 13% EMGmax). METs of JS (5.8 ± 1.1) was significantly higher than DIA (5.3 ± 1.1). Poling force in DIA (32.0 ± 13.6 N) was significantly higher than JS (21.1 ± 10.2 N).
Discussion
Small differences were observed in physiological response on walking distance, muscle activity of the triceps brachii, energy consumption, and poling power, but these differences were smaller between both types of walking.
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Contact
e-mail; fujita@nifs-k.ac.jp

AGE-RELATED CHANGES AND GENDER DIFFERENCES IN PERFORMANCE OF LONG DISTANCE RUNNING COMPETITIONS

WANG, H.S.1, TUNG, K.1, CHAO, H.H.2, CHEN, H.H.3

1: NTNU (TAIPEI, TAIWAN), 2: NTU (TAIPEI, TAIWAN), 3: NQU (KINMEN, TAIWAN)

Introduction
To evaluate the age-related changes and gender differences in endurance performance of top 10 and all finishers on half-marathon and marathon from 2005 to 2015 at the Fubon Taipei Marathon events in Taiwan.
Methods
The data were gathered from the Chinese Taipei Road Running Association. Among the total number of 152,899 finishers, the age group was divided by every 5 years, three years as a span (2005~2007, 2009~2011 & 2013~2015) and the average finish time of the male and female runners on half marathon and marathon was analyzed in the study.
Results
1. On the half-marathon finish time of the top 10 runners, it was significantly shorter among male runners of the age group of 20-24 and 25-29 and female runners of the age groups 20-24 and 30-34 than the top 10 runners of the age group of 35-39 and the other senior age groups ($p < .05$), while the marathon finish time of the male top 10 runners of the age groups of 25-29, 30-34 and 35-39 and female 35-39 age group were significantly shorter than that of the age group of 40-44 and the other senior age groups ($p < .05$). Finish time difference of top 10 runners between senior and younger group had a narrowing trend, in the age groups 50-54 & 45-49 of female, the difference from 11.3 % of 2005-2007 year span declined to 6.0 % of 2013-2015. The difference declined from 9.6 % of 2005-2007 year span to 5.9 % of 2013-2015 between age group 55-59 and 45-49 of male. Meanwhile, irrespective of gender and whether half-marathon or marathon, finish times of top 10 finishers of the age group 50-54 was significantly longer than that of the age group of 45-49 ($p < .05$). 2. On the average finish time of all finishers, the fastest one went to the age group of 50-54, and the average finish time of the age group of 60-64 was also significantly superior to that of the age groups between 25 and 39, while the fastest average finish time of male marathon went to the age group of 45-49. Meanwhile, the average finish time of the age group 60-64 was significantly superior to the age groups between 20 and 34. As for female half-marathon, the average finish time of the age group 45-49 was significantly superior to the younger age groups between 20 and 39 ($p<.05$). However, compared to the other senior age groups, there was no significant difference. There was also no significant difference between age groups in the female marathon.
Discussion
From the aspect of competition, the age of 35 and 40, or a younger age are a better age for an athlete to achieve a better performance in the half-marathon and marathon respectively, and the performance will degrade here after, and both genders show the downward tendency more significantly after the age of 50. However, from the aspect of maintaining health, master runners who keep regular exercise training will achieve the competence of endurance capacity not inferior to younger runners.

EFFECT OF CLIMBING MT. FUJI ON DELAYED-ONSET MUSCLE SORENESS

TAMARI, Y.1, WADA, T.1, YOSHIDA, N.2, ONODERA, S.1
KAWASAKI UNIVERSITY OF MEDICAL WELFARE

Introduction
Mt. Fuji is the highest mountain in Japan (elevation: 3,776 m). Between July 1 and September 10, 2016, 248,000 people climbed this mountain. There are four trails that lead to the summit of Mt. Fuji. Gotemba trail is suitable for good walkers who can cope with large altitude differences and long distances up to the summit. This study aimed to clarify the factors that affected delayed-onset muscle soreness (DOMS) in climbers after climbing Mt. Fuji.
Methods
The subjects were 317 Japanese climbers who descended the Gotemba trail of Mt. Fuji. The number of valid responses was 73 (23.0%). The survey was conducted at the Gotemba trail's new 5th station (elevation: 1,440 m). The questionnaire survey was about climbing and muscle soreness. The questions were about the characteristics of the subjects (sex, height, weight, number of completed climbs, number of years of climbing experience, mountaineering frequency), their climbing experience (climbing trail, elevation of turnaround point, climbing time, backpack weight, days, number of breaks, break time), and exercise habits (number of exercise sessions per week, exercise time per session). Muscle soreness was determined based on the visual analog scale. Measurements of muscle soreness were made immediately after descending the mountain, and on post-climbing days 1–7. The muscle soreness survey paper was collected by post. The maximum value of muscle soreness observed between 12 hours and 168 hours after descending the mountain was defined as the peak DOMS score.
Results and Discussion
Muscle soreness was observed from immediately after descending the mountain. DOMS showed the highest value 24 hours after going down the mountain ($p < 0.05$). There was a significant negative correlation between the peak DOMS score and the number of completed climbs, the number of years of climbing experience, mountaineering frequency, and exercise time per session (for each variable, $p < 0.05$). DOMS that happens after climbing may be alleviated by accumulating climbing experience and longer exercise times performed on a daily basis. Climbing experience and mountaineering frequency were extracted as independent variables when the peak DOMS score was taken as a dependent variable (Prediction formula: peak DOMS score = (−0.318 × mountaineering frequency) + (−0.634 × climbing experience) + 51.304; Coefficient of determination: 0.126, $p < 0.05$). This suggests that mountaineering frequency and climbing experience are useful indices for predicting the degree of DOMS. This study revealed that the number of completed climbs, the number of years of climbing experience, mountaineering frequency, and exercise habits (exercise time per session) influenced the degree of DOMS after climbing.

EFFECT OF BADUANJIN ON POST-TRAINING PHYSICAL FUNCTION RECOVERY IN JUDO ATHLETES-A PILOT STUDY

CAI, L.1, HOU, X.H.2, PENG, X.1, WU, Y.D.2
GUANGZHOU SPORT UNIVERSITY

Introduction
To discuss the effect of Baduanjin on post-training physical function recovery in judo athletes.
Methods
Students from the judo class were randomly assigned into the experiment and control group, and were intervened for 6 weeks, with the experiment group exercising Baduanjin while the control sitting for relaxation. Athletes' heart rate, hemoglobin, gripping strength and serum testosterone were measured before and after experiment.
Results
After 3 weeks of intervention, the experiment group showed significantly higher gripping strength comparing to the control ($P < 0.05$), and after 6 weeks of intervention, the difference of heart rate before and after recovery was significantly different ($P < 0.05$), and the gripping strength became even more significant ($P < 0.01$) when compared between two groups. As for the difference of hemoglobin before and after experiment, the two groups were insignificantly different; for the difference of serum testosterone before and after experiment, the experiment group showed an increasing trend, and the difference was significant comparing to the control ($P < 0.05$).
Discussion
The 6-week hqb exercise improved judo athletes' physical function recovery, but the scientific effectiveness of Baduanjin requires further studies for verification.

EFFECTS OF CIRCUIT RESISTANCE EXERCISE ON ADIPOKINES AND INSULIN RESISTANCE IN OBESE MIDDLE-AGED WOMEN

SEO, D., SO, Y.W.
DONGGUK UNIVERSITY, KOREA NATIONAL UNIVERSITY OF TRANSPORTATION

Introduction
Adipose tissue functions as an endocrine organ, in addition to its role in fuel storage, thermal insulation, mechanical protection, and release of biologically active and diverse cytokines, termed adipokines, such as leptin and adiponectin. Leptin and adiponectin are adipokines that are strongly associated with obesity and insulin resistance However, the response of adipokines and insulin resistance to exercise training has not been clearly defined. Therefore, the purpose of the study was to examine the effects of 12 weeks of circuit resistance exercise training on leptin, adiponection, insulin resistance, and blood lipids in obese women.
Methods
The participants were randomly assigned into exercise group (n=10) and control group (n=10). Exercise sessions were performed 3 times per week for 12 weeks. The circuit resistance exercise training consisted of walking and resistance exercise at 60~80% of heart rate reserve for 50 minutes.
Results
Leptin, adiponectin, HOMA-IR, TC, TG, HDL-C, %body fat, and body weight were significantly changed in exercise group ($p<.05$). LDL-C was not significantly changed.
Discussion

We found that circuit resistance exercise training produced improvement of adipokines, insulin resistance, blood lipids, and body composition in obese middle-aged women.

KEEN ON SPORT AND POOR IN MOVEMENT

SPRECKELS, C., WOLLESEN, B.

UNIVERSITY OF HAMBURG

Introduction
It is well-known that less and less people, although they are aware of the importance of sport and movement concerning their health, float in measures conducive to health or regularly sport. Even with keen on sport football fans. The aim of this study is to determine the motives for the sports enthusiasm on the one hand and the lack of own sportive and health motivation on the other side and the possible correlation both.
Methods
Why this is in such a way, it was analysed on the basis of interviews with keen on sport people who are passionate football fans. Moreover guide-supported interviews with eight fans of the HSV, three of the FC St. Pauli and in each case to one of the BVB Dortmund and from Bayern Munich became carried out. The hypothesis is that the principal reason lies in the lack of offers specific for personality. The thesis was supported by purposeful questions in view of implicit personality qualities or in the personality unconscious implicit motives. Base for the classification is the Personality-System-Interaction-Theory – PSI – of Kuhl (2004).
Results
Beside the abovementioned thesis which are confirmed lack of time just as the internal barrier determined as a reason for the lacking sports activity.
Discussion
Because all football fans, all the same from which club, gave that a reason for not doing any sportive activities is the solidarity they find in the stadium, which they do not find in optional sport activities. Adaptable offers to the teams sport are absent, with the individuation of the leisure sport they do not find themselves or are not to be motivated by the offers in fitness studios with lasting effect, because the team thought or the feeling of the common experience is absent.
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THE EFFECT OF SOFT AND HARD SURFACE INTERVENTION ON GROUND REACTION FORCE OF DIFFERENT SLOPES IN THE ELDERLY

LIN, Y.C., WU, C.L., WONG, T.L.

NATIONAL TAIWAN SPORT UNIVERSITY, NATIONAL TAIWAN NORMAL UNIVERSITY, NATIONAL TAIPEI UNIVERSITY OF EDUCATION

Introduction
Population aging is a common trend in the world, the effects of aging bodily functions. Walking is the ability to perform physical movement, is also the performance of the lower limb to the ground. It is the highest reproducible periodic motion in lower limb movement. Repetitive movement of the project, the lower limb injury has a higher incidence (McAuley, 1991). The effect of walking slopes is two to three times that of the ground (Lay et al., 2006). Different soft and hard surface will affect the ground time, joint angle, ground force and other factors change, thereby reducing the impact of the ground, reduce the chance of walking down (Leroux et al., 2002). Therefore, the goal was to explore walking in different slopes （12°、0°、-12°）with different hard and soft surface to Ground reaction force in The Elderly.
Methods
Eight over age 65 years old without a history of leg pain sixth grade male students (age: 68.50±3.89 years old, height: 164.50±5.73 cm, weight: 70.63±7.38 kg) subjects. Use an AMTI force plates (1000Hz) to collect Ground reaction force of lower limbs. The primitive signal from the force plate is processed by DasyLab 6.0 software, filtering and calibrates modular to calculate the primitive GRF. Body weight (BW) is used as the basis for standardization to obtain GRF values. The resulting data undergoes two-way ANOVA via SPSS 12.0 statistics software (SPSS Inc., USA) was used in this study for statistics and analysis.
Results
With the softening of the material, during braking phase, the first peak force time increases, the average loading rate decreased, 50ms passive impulse to reduce reached statistically significant difference ($P < .05$). Shows soft material can reduce the ground when the feet touch the ground to with stand the impact of ground reaction force and the extension of the occurrence time of peak force.
Discussion
Walking in the soft surface of the slope, there will be load of average loading rate and 50ms passive impulse, and reduce the ground force caused by running the impact of the slope, thus reducing opportunities for travel fell. After the intervention, through soft material, this slope movement should join the training function for the lower extremity sports injuries, have a positive benefit.
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ASSOCIATION BETWEEN MUSCLE STRENGTH AND RISK OF FALLS IN OLDER WOMEN

FONSECA, A.1, NERI, S.1, CORREIA, A.L.1, LIMA, R.1
UNIVERSITY OF BRASILIA

Introduction
Muscle strength with aging and induce a variety of functional impairments in older people, such as a reduced performance in daily living activity and an increased incidence of bone fractures (Miszko et al., 2003). Since the ability of muscle tissue to generate force is an important factor to maintain balance (Wolfson et al., 1995), it has been suggested that reduced muscle strength increase the risk of falls in older people. Therefore, the purpose of this study was to investigate the relationship between knee extensors muscle strength performed in different velocities and risk of falls in older women.
Methods
One hundred sixty-five older women (70.0 ± 5.52 years; 1.55 ± 0.06 m; 66.05 ± 12.17 kg) took part in this cross-section study. Dominant knee extensors muscle strength was measured using an isokinetic dynamometer (Biodex System 4). Briefly, subjects performed 2 sets of maximum isometric contractions during 4s, followed by 2 sets of 4 maximum knee extension at 60°/s and 2 sets of 4 maximum knee extension at 180°/s. A rest-interval of 60 seconds was kept between sets. The risk of falls was evaluated using the QuickScreen Clinical Falls Risk Assessment. The relationship between muscle strength and risk of falls was examined using the Spearman Correlation coefficient. Statistical significance was set at $p < 0.05$.
Results
Mean values of absolute and relative isometric PT were 98.10 ± 26,25 N.m and PT 150.2 ± 45.66%, respectively. Mean values of absolute and relative PT at 60°/s were 85.5 ± 24.92 N.m and 128.5 ± 38.85%, respectively, while for 180°/s were 57.3 ± 28.87 N.m. and 87.5 ± 24.22 %, respectively. According with the assessment of the QuickScreen, the risk of falls 22 older women showed 7% of risks of falls, 72 has 13%, 33 has 27% and 38 has 49% of risk of falls in the next 12 months. The risk of falls was associated with relative isometric PT (ρ = - 0,291, $p < 0,001$), relative PT 60 °/s (ρ = - 0,359, $p < 0,001$), and relative PT 180 °/s (ρ = - 0,319, $p < 0,001$).
Discussion
Knee extensors muscle strength was negatively associated with risk of falls in older women. Therefore, we suggest that strategies for maintenance and improvements of muscle strength, such as resistance training, should be encouraged in the elderly.
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Contact
andrewcfonseca@gmail.com

PHYSICAL ACTIVITY POSITIVELY AFFECTS STRUCTURAL CONNECTIVITY OF THE BRAIN

PRATS-PUIG, A., BLASCO, G., FERNÁNDEZ-GONZÁLEZ, D., PUIG-PARNAU, M., ROMÁN-VIÑAS, B., FORT-VANMEERHAEGHE, A., PEDRAZA, S., PUIG, J., FONT-LLADÓ, R.
UNIVERSITAT DE GIRONA

Introduction
To study the association between physical activity practice during childhood and changes in the brain tractographybymeans of diffusion tensor imaging (DTI)at the adulthood.
Methods
Weperformedbrainmagnetic resonance imaging (MRI) on 24 healhty adults (14 female; age 40.2±11.4 years) using a 1.5 T scanner. Imaging protocol included DTI with 16 diffusion-sensitized gradients appliedalong 15 non-collineardirectionswith a b-value of 1000s/mm2andanatomical T1 turbo-fieldechosequence. Axial diffusivity (AD), radial diffusivity (RD), meandiffusivity (MD), andfractionalanisotropy (FA) mapswerecalculatedusing Olea Sphere 3.0 software (Olea Medical, La Ciotat, France). FSL tools (FMRIB, Oxford, UK) wereused for imagenormalizationandwhitemattertracts DTI-metricswereobtainedfromICBM-Atlas. Physical activity in childhood was assessed usingself-reported questionnaires. The relation between variables was analyzed by Spearman correlation followed by multiple regression using the enter method.
Results
Regular sport practice before 16 years of age was positively related the mean FA of the rightfascicle of posterior corona radiate ($r=0.545$; $p=0.013$) and the left posterior limb of internalcapsule ($r=0.652$; $p=0.001$), areas of white matter. All these associations remained significant after correcting for confounding variables such as: age, gender and educational level.
Discussion
Regular sports practice before 16 years of age positively affects structural connectivity of the brain. The main modified regions in healthy adults are the corona radiate and the internal capsule, both areas with motor and sensory fibers in charge of carrying information to and from the cortex.

THE IMPACT OF AN ADDITIONAL LOAD OF 40 KG ON THE PHYSIOLOGICAL PERFORMANCE AND THE EFFECT ON THE VENTILATORY THRESHOLDS

KLUGHARDT, S.
UNIVERSITÄT DER BUNDESWEHR MÜNHEN

Introduction
The aim of this study is the leading question whether an additional load of 40 kg will decrease the performance in the range of the ventilatory thresholds during a treadmill test. Second issue is the influence of well-trained aerobic endurance on performance with an additional load of 40 kg so the load can be compensated and may avoid a decrease in performance.
Methods
15 male students (age:23,5±1,6 years, height:1,81±0,6m, bodyweight:79,9±8,3 kg, body fat:15,0±4,4%) participated as subjects for this study. On two separate days, including a regeneration time of 48h, the students completed two ramp test on a treadmill in loaded (40 kg) and unloaded conditions. The test started at a speed of 4 km/h and rises continuously 1 km/h per minute until exhaustion.

Results
With 40 kg additional loading, pace and time were significantly reduced on the ventilatory threshold 1 (-28%/-29%) and ventilatory threshold 2 (-30%) but the breathing frequency increases about 11% (29±8/min=>33±8/min). The reduction in pace, time, heartrate, VO2, VO2 rel. and the increase of breathing frequency can be significantly correlated with the impact of well-trained aerobic endurance on performance with an additional load (40 kg). All parameter offers a positive correlation in a high (p<0,05*) and highest significantly (p<0,001**) range: time (VT1: r=0,820**/VT2: r=0,725**), pace (VT1: r=0,824**/VT2: r=0,722**), heartrate (VT1: r=0,647**/VT2: r=0,571*), VO2 (VT1: r=0,646**/ VT2: r=0,533*), VO2 rel. (VT1: r=0,635*), breathing frequency (VT1: r=0,836**/VT2: r=0,750**).
Discussion
There is a high impact of 50 percent of body weight to exercise performance. It can be supposed that long-term damaging in overload may appear. Not only strength training may have a positive impact but an aerobic endurance training is hugely important.
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Contact
saskia.klughardt@unibw.de

CHANGES IN PHYSICAL ACTIVITY OF OLDER PEOPLE IN DIFFERENT SEASONS OF THE YEAR

KRÓL-ZIELIŃSKA, M., CIEKOT-SOŁTYSIAK, M., KANTANISTA, A., ZIELIŃSKI, J.
POZNAN UNIVERSITY OF PHYSICAL EDUCATION

Introduction
Physical activity of people living in countries in climates with varying weather conditions can change depending on the successive seasons (Shephard and Aoyagi, 2009; Togo et al., 2005). Previous reports suggest that elderly people decrease their physical activity from spring or summer to winter. There are very few studies on physical activity among older adults in different seasons made by objective methods and the results still remain unclear. The aim of this study was to measure changes in physical activity among the free-living elderly in consecutive seasons of the year.
Methods
The measurement of physical activity (energy expenditure) in four varied seasons was carried out using accelerometers. Eighty older people (age 72.0 ± 5.5 years) wore the accelerometer at the waist for a week in the middle of each season.
Results
There were significant differences ($F(3, 180) = 9.1782$, $p < .001$) in the level of physical activity expressed as energy expenditure among older people, depending on the season of the year. Energy expenditure was highest in spring and significantly higher ($p < .001$) than in autumn and winter. During winter, energy expenditure was lowest and significantly lower ($p < .001$) than the energy expenditure during the spring and summer.
Discussion
Obtained results suggest that changes in the level of physical activity depend on the seasons of the year and should be taken into account especially by researchers who carry out one-time measurements of physical activity of elderly people. For health promotion, it is important to maintain physical activity at the recommended minimum despite weather conditions (Shephard and Aoyagi, 2009). During the less favorable weather conditions (e.g. in winter and autumn) older people could use available forms of indoor physical activity.
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Contact
krol-zielinskamagda@wp.pl

RELATIONSHIP OF PHYSICAL FITNESS WITH PHYSICAL ACTIVITY IN PRESCHOOL CHILDREN: A CROSS-SECTIONAL STUDY IN SHANGHAI

CHEN, P., FANG H., WANG R., QUAN M., ZHANG H., ZHANG J.
SHANGHAI UNIVERSITY OF SPORT

Introduction
To evaluate the relationships between physical fitness and objectively measured physical activity among preschool children in Shanghai.
Methods
A total of 346 participants (201 boys and 145 girls) aged 3.5-5.5year-old (M=4.5yr, SD=0.47) completed all the physical fitness assessments, including triceps skinfold thickness, grip strength, tennis throwing, sit & reach test, standing long jump, balance beam, 10mshuttle run test (10mSRT) and 20m shuttle run test(20mSRT). Physical activity was objectively measured by accelerometer ActiGraphGT3X+. Multiple linear regression models were used to explore the cross-sectional associations between physical fitness and PA after adjusting for age, gender and BMI.
Results
After adjustment, positive associations were observed between stand long jump($p<.001$), tennis throwing($p<.001$),laps in 20mSRT ($p<.001$) and MVPA, whereas triceps skinfold thickness($p<.05$), time in 10mSRT($p<.001$), balance beam($p<.05$) were negatively associated with MVPA. Time in 10mSRT ($p<.05$) and balance beam($p<.05$) were also negatively associated with LPA. Further, positive associations were found between stand long jump ($p<.001$) , tennis throwing ($p<.001$) and MVPA, negative associations between triceps skinfold thickness($p<.05$)and MVPA only in preschool boys. Negative associations were noted between time in balance beam ($p<.05$) and MVPA only in preschool girls.
Discussion
MVPA appears to be an effective and reliable predictor of preschool children's physical fitness. Boys' body composition, muscular strength, explosive strength, agility and aerobic fitness could improve if they get more MVPA. For girls, agility, aerobic fitness and balance will be enhanced if obtain more MVPA.

CONSIDERATIONS ON FACTORS OF HIDDEN OBESITY IN YOUNG JAPANESE WOMEN.

OHTA, M.1, MITA, Y.2, OGAWA, M.3, TANAKA, N.3

1: CHUKYO UNIVERSITY (TOYOTA, JAPAN), 2: SUGIYAMA JOGAKUEN UNIVERSITY (NAGOYA, JAPAN), 3: NAGOYA UNIVERSITY (NAGOYA, JAPAN)

Introduction
In order to live a healthy and active life for a lifetime, it is indispensable to have fitness habits while young and acquire sufficient skeletal muscle mass. However, in recent years, it is pointed out that young women have low executing rates of exercise and that they have desire to be thin in Japan. These situations may lead to future sarcopenia obesity. Therefore, this study aims to explore factors of hidden obesity by examining muscle strength, physical activity level, and nutritional state between a normal weight group and a hidden obese group in young women.
Methods
Subjects were 29 young Japanese women (age: 20.3±0.4 yr, height: 156.0±6.3 cm, weight: 47.7±5.1 kg). Body composition was measured by the bioelectrical impedance method and ultrasound method. Then we separated them into two groups: the normal group (n = 16) is BMI <25 kg/m^2 and body fat percentage < 25%, and the other was classified as hidden obese group (n = 13) with BMI <25 kg/m^2 and body fat percentage ≧25% . We obtained data on muscle strength, physical activity, and nutritional status. In addition, we investigated desire to be thin, and fitness habits using questionnaire.
Results
There was no significant difference between the two groups in skeletal muscle mass of whole body, bone strength, nutrition intake, physical activity level and fitness habits. The muscle strength of the trunk was significantly higher in the normal group than in the hidden obese group (back muscle strength: p = 0.007, the number of abdominal crunch: p = 0.027). In addition, knee extension muscle strength also tended to be higher in the normal group (p = 0.062). In the self-evaluation of the body type, many in the hidden obese group responded that they were "fat". (p = 0.001).
Discussion
We hypothesized that lower physical activity and nutritional deficiency were involved in the factors of hidden obesity, but our results were different. However, trunk muscle weakness in hidden obese group was confirmed. Comparing with the same BMI, people with a higher body fat percentage look. This fact seems to have led to the evaluation of the body shape. We may need a careful examination on fitness habits and diet behavior in future study.
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Contact
Megumi Ohta [m-ohta@lets.chukyo-u.ac.jp]

HEALTH BEHAVIORAL FACTORS IN MODERN ADOLESCENTS IN RUSSIAN FEDERATION AND REPUBLIC KAZAKHSTAN

FYODOROV, A., SIVOKHIN, I., MAMIEV, N.

SOUTH URAL STATE UNIVERSITY

Introduction
Adolescence is a critical period of biological and psychological alteration in an organism, including social adaptation; it is a period of attempts to assimilate new types of behavior, new social roles, and new social experiences.
Because of these changes, scientific and practical essentiality is seen in studies on health behavior in modern adolescents.
Purpose of the research - to study health behavioral factors in modern adolescents.
Methods
In our study we used a specially designed questionnaire with more than 126 questions. The questions were organized into several conceptual themes: nutrition, physical activity, positive health, family culture, peer culture, behavioral risk, and bad habits (C. Currie et al., 2012).
The research survey was conducted in February–March 2010 at ten schools in Chelyabinsk (n=1440) within the framework of the international scientific programme 'Health Behaviour in School-aged Children' (A. Fyodorov, 2016).
Results
Health behavior in modern adolescents may be specified by the
following indices:
– health assessment (self--assessment) by adolescents;
– medical awareness;
– bad habits;
– ecologic sets;
– stress factors;
– physical activity level.
Discussion
The factors determining school-aged children's health condition are complex, modern russian adolescents' health may be regarded as critical. Based on the analysis results of the study were sent on mission revealed gender differences in attitude of adolescents towards their health. In this study indices of health self--assessment are lower in girls than in boys of the same age. Over recent years there has been a steady increase in health risk factors as alcohol addiction, smoking, drug addiction, higher influence of stress factors, and lower levels of physical activity among these adolescents. Nearly half of adolescents of all ages suffer nervous strain at least once a month. The most prominent gender-based differences are observed in adolescents at the age of 13 when 5.4% of boys and 18.4% of girls suffer nervous strain.
Personal anxiety levels in boys in all age groups are lower than in girls of the same age. Many modern adolescents have not formed a need for systematic physical exercise, and many adolescents show a low level of physical activity. Girls have a lower level of physical activity than boys of the same age. In general, study results indicate the necessity of further research on adolescents' health behavior.
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EIGHT MINUTES OF ISOMETRIC CONTRACTION IMPROVES HEMODYNAMIC PARAMETERS IN HYPERTENSIVE INDIVIDUALS

OLHER, R.R, SOARES, B.R.A, RIBEIRO, T.B.A, SOUSA, I.R.C, ROSA, T.S, MORAES, M.R.
CATHOLIC OF BRASÍLIA UNIVERSITY

Introduction
To determine the effects of isometric exercise (IE) over hemodynamic parameters in individuals with and without hypertension.
Methods
Five normotensive (NTG) and 5 hypertensive (HTG) individuals were enrolled (n= 10). Subjects were submitted to three sessions of isometric exercise in the bench press and leg press 45º. The first session consisted in a test of maximum voluntary isometric contraction (MVIC). The bench press MVIC test was determined by the highest sustained load for 3 seconds at the point of greatest pectoral muscle strength (90° elbow angulation). In the leg press a load cell was used (Power Din Pro, CEFISE, SP, Brazil) coupled in parallel to the load implementation axis. After MVIC determination, the participants underwent two sessions of IE, each one consisting of four contractions of 1' and 2' of rest pauses between contractions. Being one session with 30% MVIC and a non-exercise control session. All sessions had an interval of 72 hours between one and the other. For the analysis of the hemodynamic variables, an automatic blood pressure monitor (Microlife - BPA100, Switzerland) was used, measurements were performed at rest, 5', 10', 15 ', 30', 45 'and 60' post test.
Results
HTG presented a significant decrease in systolic blood pressure (134mmHg at rest, to 120 mmHg at 45' recovery), mean arterial pressure (101mmHg at rest to 91mmHg and 94mmHg, at the 10' and 45' recovery measures, respectively), and double product (9247bpm×mmHg at rest to 7468bpm×mmHg, 8165bpm×mmHg and 7595bpm×mmHg at 15', 30' and 45' recovery measures, respectively. No statistical differences were identified for the normotensive group.
Discussion
In conclusion, eight minutes of isometric contraction of two muscle mass large groups (pectoral and quadriceps) were efficient in improving hemodynamic parameters in hypertensive subjects. Therefore, this type of exercise could be a good alternative in non-pharmacological control of hypertension.

History

THE PECULIARITY OF THE BUDO AS PART OF THE PHYSICAL ARTS CULTURE : FOCUSING ON THE HISTORICAL EVOLUTION OF BUDO

TAI, K.
NAGASAKI INTERNATIONAL UNIVERSITY

Currently, the martial arts are compulsory in the health and physical education program in the Japanese school system. As for the content of the martial arts that must be learned, through mastering basic movements and techniques of "the physical arts culture which is unique to Japan," learners are expected to observe "ways of traditional behavior" and to comprehend the "characteristics and origins of the martial arts" and "traditional ways of thinking."
Preceding studies have found that the martial arts as part of the physical arts culture have been influenced by the incoming western physical culture in the modern period. As preceding studies have shown, when examining martial arts' traditions, due attention needs to be paid to institutions and functions that have been established and added in the modern period. At the same time, to investigate the characteristics of physical arts culture that are unique to martial arts, an inquiry into the historical processes of physical arts culture before the arrival of modernity is indispensable. This study examines the peculiarity of the martial arts as part of physical arts culture, focusing on the early modern period when major social change took place.
The early modern period saw major changes in social institutions, ideology, and customs due to the shift from the Age of Civil Wars to the Edo Period, and that period exercised major influence on physical arts. To examine these, the presentation uses "Heiho"series-the Military Tactics Manuals, which are volumes on the arts of war and combat of the time. The martial arts have two major dimensions: they are physical arts as technique of combat, and they define the subject that deals with the martial arts. Consequently, the following aspects are examined to explore their historical origins:
1. Changes in the art of combat from the medieval to the modern periods;
2. Changes in the definition of the subject that deals with the martial arts from the medieval to the modern periods.
The military tactics manuals of the early modern period describe ways to understand how to handle one's body as well as the combat techniques to utilize. Modern martial arts have a function not only to train for the purposes of killing and injuring, but also to realize the ideal way of being for the bushi through practice. In other words, they have a function that manifests certain values by way of the body. If contemporary learners and practitioners of martial arts have a similar experience, what kinds of values are in the background? With educational expectations regarding the martial arts increasing, it is still important to clarify the basic concepts regarding traditional physical exercise culture.
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Molecular Biology and Biochemistry

EFFECTS OF ESTROGEN AND EXERCISE ON RYANODINE RECEPTOR EXPRESSION AND PHOSPHORYLATION

ZÜGEL, M., WEHRSTEIN, F., SCHUMANN, U., WEIGT, C., DIEL, P., STEINACKER, J.M.

ULM UNIVERSITY

Introduction
Contractile force of skeletal muscle decreases during aging, in particular after the onset of menopause in women. The ryanodine receptor 1 (RyR1) and the dihydropyridine receptor (Cacna/DHPR) are essential components of electromechanical coupling in skeletal muscle, which transforms an electrical impulse into mechanical action. Phosphorylation (pRyR1Ser2843) of the RyR1 destabilizes the closed state of the receptor and thereby increases calcium (Ca++) leakage from the sarcoplasmic reticulum (SR), which compromises contractile function.
Methods
The aim of the experiments was to explore a potential mechanistic link between estradiol (E2) levels and molecular regulation of RyR1 activity. We hypothesized that deviation from physiological E2 concentrations leads to remodeling of the RyR1 (pRyR1Ser2843), which is associated with modification in the Ca++ homeostasis of the muscle cell. C2C12 myoblasts were differentiated in-vitro to myotubes and treated with physiological as well as supra-physiological E2 concentrations (1-100 nM). In addition, female Wistar rats were ovariectomized (OVX) or sham operated (Sham) and a subset of OVX animals was additionally trained on a treadmill (10 min, 1x/day, 5 days/week, 22 m/min, 5% incline). Expression of Ca++ channels and receptors was determined at the mRNA (RyR1, Cacna) and protein (RyR, pRyR1Ser2843) level by qPCR and Western Blot.
Results
Supra-physiological E2 concentrations resulted in significantly reduced RyR1 mRNA expression (0,34-fold 5nM vs. control, $p<0,05$) and increased RyR1 phosphorylation in C2C12 myotubes (1,77-fold 10nM vs. control, $p<0,05$). Lack of E2 (OVX) resulted in significantly increased mRNA levels of Cacna (1,45-fold OVX vs. Sham, $p<0,05$) and RyR1 (1,32-fach OVX vs. Sham, $p<0,05$). Protein expression of RyR1 was also increased after OVX (2,31-fold, $p<0,05$). Exercise training resulted in a partial compensation of OVX-induced effects.
Discussion
Our results are in accordance with the hypothesis that alterations in E2 concentrations are associated with modulation of skeletal muscle Ca++ homeostasis through changes in RyR1 and Cacna expression and activity. These findings are relevant to understand deterioration of skeletal muscle contratile function in women during menopause.

THE EFFECT OF EXERCISE TRAINING ON ADROPIN IN OBESE RATS

HIEDA, M.1, TAKAKURA, H.2, KOMINE, H.3

1:TOYOHASHI UNIVERSITY OF TECHNOLOGY, 2:DOSHISHA UNIVERSITY, 3:NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY

Introduction
Adropin is a peptide hormone and is important for energy homeostasis and insulin sensitivity. Low adropin levels may associate with a higher risk of obesity and insulin resistance. In human subjects, a previous study reported on the low levels of plasma adropin in diabetic patients. Aerobic exercise has been extensively investigated and shown to be beneficial for improving insulin sensitivity and lipid profile. The aim of this study was to test the hypothesis that aerobic exercise affects the concentrations of adropin in the plasma, heart and liver tissues of rats.
Methods
Male Zucker rats were randomized into three groups, lean control (LC), obese control (OC) and obese exercise training group (OE). Food intake and body weight were monitored weekly. The OE were trained on a treadmill. 30 min/day, 5 days/wk, for 6 wks. The speed commenced at 14 m/min and was increased by 2 m/min every minute, until a maximum speed of 24 m/min was reached. After six weeks, the animals were euthanized. Adropin concentrations in the plasma and tissue supernatants were measured by ELISA.
Results
Compared with the LC group, the obese rat groups (OC and OE) exhibited a greater food intake and higher body weight. Body weight was lower in the OE group compared to the OC group ($p < 0.05$). Increased adropin immunoreaction was seen in the plasma in the obese rat groups (OC and OE) compared to the LC group ($p<0.05$). Plasma adropin levels were significantly higher in the OE group than in the OC group ($p < 0.05$).
Discussion
Adropin in the plasma is higher in the obese rat groups (OC and OE) compared to the LC group. This result was consistent with Aydin et al. (2013). This suggests that increased adropin in the obese might have a role of compensating during the development of the disease. We also observed that the plasma adropin concentration in the OE group was significantly higher than in the OC group. This suggests that adropin levels are affected by physical exercise.
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Contact
mhieda@las.tut.ac.jp

COMPARISON OF REFERENCE INTERVAL OF BLOOD INDICS BETWEEN SPORT BIOCHEIISTRY AND CLINICAL MEDICINE

FENG, B.X., YANG, X.Y., LI, P.F., ZHANG, W.Y.

CHINA INSTITUTE OF SPORT SCIENECE

Introduction

The aim of this study was to monitor the long-term physical function of Chinese elite athletes by measuring the commonly biochemical indicators in clinical medicine. With statistical analysis of large sample data, the reference intervals of blood indices for sport biochemistry laboratory detection in elite athletes were compared to those for clinical medicine laboratory detection in general population.
Methods
The blood samples from 1205 athletes (668 males, 537 females) were collected on the next morning after the athlete's normal training. Complete blood count (CBC), blood urea nitrogen (BUN), creatine kinase (CK), serum testosterone (Testo) and serum cortisol (Cort) were detected in sport biochemistry laboratory. Using SPSS 18.0 software, statistical analysis of data was completed. On the basis of X plus 1.96 s, 95 percent confidence interval was developed. The reference intervals of blood indices from athletes were established and compared to those from ordinary people detected in clinical medicine laboratory.
Results
There was no significant difference in CBC reference interval between athletes and the general population. It was showed that training has no significant effect on the change of CBC level. The CBC reference interval in clinical medicine can be used to evaluate the body-function of athletes. 2) The 95 percent reference intervals of BUN & CK from athletes were respectively 4.28-9.53 mmol/L in male group, 3.79-8.62 mmol/L in female group and 93-1225 U/L in male group, 66-465 U/L in female group. 3) The 95 percent reference intervals of Testo & Cort from athletes were respectively 281.90-843.43 ng/L in male group, 12.20-76.35 ng/L in female group and 7.92-21.72μg/L in male group, 9.58-23.14μg/L in female group. 4) Compared with the reference intervals of blood indices in clinical medicine, BUN, CK, Testo and Cort reference intervals from athletes were higher. There was significant difference of Testo level in female group and Cort level in male & female group, but no significant difference of Testo level in male group.
Discussion
The reference intervals of BUN, CK, Testo and Cort from athletes were built. It is suggested that all of the reference intervals may be helpful for the laboratory monitoring of athletes group.
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Contact
fengbaoxin@ciss.cn.

Motor Learning and Motor control

ACCURACY OF VERTICAL JUMPS TO SPECIFIC HEIGHTS IN BASKETBALL

STRUZIK, A., PIETRASZEWSKI, B., KAWCZYŃSKI, A., WINIARSKI, S., JURAS, G., ROKITA, A.
UNIVERSITY SCHOOL OF PHYSICAL EDUCATION

Introduction
Jumping abilities are required for both offensive and defensive activities in basketball. In all of these activities players often aim to jump to a specific height rather than to the maximum height, although the target height is often near the maximum. Connected and repeated jumps must also be performed at specific heights (McClay et al. 1994). Therefore, the height of a jump depends strongly on the temporary situation on the court. The aim of this study is to determine the level of ability to control jump height with respect to maximum jumping ability.
Methods
The measurements were performed in a group of 28 youth male basketball players. Each participant performed 8 countermovement jumps with arm swing (CMJ). The jumps were repeated two times to the following heights: maximum height (hmax), 25% hmax, 50% hmax and 75% hmax. The two maximal height jumps were performed first. Then, the participants were given the following instructions: 'Knowing the maximum height you are able to jump to, perform a jump at 25%, 50% and 75% of your maximum abilities.' The jump accuracy to a specific height was calculated as a mean of the percentage and the sum of errors methods according to the equations in Struzik et al. (2014). The ground reaction forces during CMJs were recorded with an ACCUPOWER force plate (AMTI, Watertown, MA). The jump height was calculated based on the time of the flight phase.
Results
Hmax reached 41.0 +/- 7.6 cm. According to the methodology of Struzik et al. (2014) mean value (+/-SD) of jumping accuracy (total errors method) for 25% hmax, 50% hmax and 75% hmax were 7.0 +/- 3.1, 6.4 +/- 2.9 and 3.1 +/- 2.0 cm, respectively. Whereas, jumping accuracy calculated as percentage methods reached 70.3 +/- 33.4% for 25% hmax, 32.5 +/- 15.6% for 50% hmax and 10.0 +/- 6.1% for 75% hmax.
Discussion
Increasing the target jump height increases the accuracy of reaching the desired height. Jumps to 25% hmax were approximately two times higher than the target height, which might reflect a lack of ability to work with submaximal loads. A player who jumps lower might miss the ball, whereas a player who jumps higher might lose time. Therefore, the decreased jump accuracy to a specific height when attempting to jump to lower heights should be reduced with training, particularly among basketball players in which success requires accurate and well-controlled jumping.
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Contact
artur.struzik@awf.wroc.pl

P300 POTENTIAL INDUCED BY BADMINTON SMASH RECEIVE VIDEO CLIP

SUDA, K.1, ORIHASHI, Y.1, FUMOTO, M.2, USUI, S.2, HIGASHIURA, T.3, KODERA, T.1, UMEBAYASHI, K.4, NISHIHIRA, Y.5
1: TOKYO INSTITUTE OF TECHNOLOGY (TOKYO, JAPAN), 2: TOKYO INTERNATIONAL UNIVERSITY, 3: ASIA UNIVERSITY, 4: OSAKA UNIVERSITY OF HEALTH SPORTS SCIENCES, 5:UNIVERSITY OF TSUKUBA

Introduction

Brain wave, especially event related potentials (ERPs) have been used for studying the activity of the brain at various human situations. Concerning athletes, a review was reported for cognitive activity (Nakata et al. 2010). Since it is small electrical variation, averaging is necessary to measure ERPs. So it is very difficult to measure ERP during sports because exactly the same situation does not happen. By using badminton smash video clips, we made similar situation of playing the sports for the brain. And we tried to measure P300 potential when reacting just like receiver of smash. P300 is considered to relate several cognitive matters such as usage of cognitive resource quantity, expectation and so on.
Methods
14 badminton experts and 12 novices participated for this study. 3 kinds of video clips were made. 1) badminton smash movie to the right side or the left side of the receiver (badminton). 2) Arrow appeared random to the left or the right on badminton smash still picture (select), 3) Arrow appeared prefixed direction (simple). The participant reacted by pushing button by the hand the video clip shuttle or the arrow directed. EEG was recorded and the P300 were analyzed from Pz electrode from at least 20 trials of each condition. Data from the participant whose EEG recording was not enough because of artifacts were excluded. ANOVA was used for the statistics.
Results
Amplitude was significantly larger in experts for the badminton condition, but there was no significant difference in select and simple condition between the two groups. Latency was significantly larger in badminton movie condition. We also measured recovery time, which is the time between the peak of P300 to the instance when the curve returns to the baseline. There was no significant difference in recovery time between the groups or conditions.
Discussion
Larger amplitude in the experts group can be considered that the expert group used more resources for the badminton task. But no significant amplitude difference between the two groups for simple and select task reflects similar quantity of resource was used for the simple and select task in both groups. Larger latency in the badminton movie condition can be considered as difficulty compared to select and simple condition. The result of recovery time suggests cognitive duration related P300 was similar between the groups and the conditions.
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Contact
suda@ila.titech.ac.jp

INFLUENCE OF FULL-MARATHON RUNNING ON FORCE CONTROL AND PROPRIOCEPTION IN KNEE JOINT

NAKAGAWA, K., IIZUKA, S., INAMI, T., YONEZU, T., HIGASHIHARA, A., ABE, T.
WASEDA UNIVERSITY

Introduction
Running full-marathon have been becoming popular but can damage mechanical property and function of lower limbs. Previous studies have been shown decrease in maximal joint torque, jump performance and increase in serum creatine kinase following a full-marathon (Nicol et al. 1991; Tojima et al. 2016). However, no study focused on changes in neural function such as force control or proprioceptive sense. In this study, we aimed to investigate the influence of full-marathon running on force control and proprioceptive sense in knee joint.
Methods
Ten university students participated in this study. They participated in full-marathon race and complete the race. Before and immediately after the race, we measured force steadiness, force sense and proprioceptive sense as well as maximal torque. Subjects performed following two types of submaximal (20% MVC) force matching tasks; 1) sustained isometric contraction of right knee extensor with visual feedback for 15 seconds, and 2) 20 ballistic contractions with no visual feedback. We calculated force fluctuation during sustained phase (10 seconds) for evaluating force steadiness as well as absolute errors for force sense. In knee proprioception task, subjects actively replicated target joint angle (30 and 70 degree) with no visual feedback. We calculated absolute errors to the target angle for evaluating proprioceptive sense.
Results
Maximal knee extension torque significantly decreased following the marathon race. There was no significant change in force steadiness and force sense for force matching tests. In knee proprioception, absolute error significantly increased after the marathon race when the target angle was 30 degree.
Discussion
We could observe deterioration in knee proprioceptive sense, but not in force steadiness and force sense after full-marathon. The general consensus is that these indices deteriorate after the general muscle fatigue tasks (Furness et al. 1977; Vuillerme et al. 2008; Hiemstra et al. 2001). Thus the damages by full-marathon might be special with comparison to general muscle fatigue tasks. In conclusion, full-marathon running would not influence ability of low-intensity force control but can degrade proprioceptive sense.
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Contact
nakagawa.kento.22@gmail.com

INFLUENCE OF LOW LOAD WEIGHT AND DEFFERENT MOVEMENT DIRECTION ON THE KNEE POSITION SENSE

HAYAMI, T.1, HIRONO, J.1, KIZUKA, T.2
1: SHINSHU UNIVERSITY (NAGANO, JAPAN), 2: UNIVERSITY OF TSUKUBA (IBARAKI, JAPAN)

Introduction
Kinesthesia that related human joint angle (position sense) had been estimated by a reproducibility of joint angle has used for the estimation of position sense, and previous studies reported the effect of fatigue, aging, or injuries on the human joint position sense by using the reproduction of joint angle task. In that task, participants reproduce their joint angle toward to target angle. The initial angle was fixed,

and the target angle was set different angle in the previous research. However, it is unclear that the reproducibility of joint angle form the different initial angle to the same target angle. In addition, afferent inputs from muscle spindle are mainly contributed to forming kinesthesia. Therefore, it is well known that human position sense is changed by the various load weights.
The purpose of this study was to investigate that the reproducibility of knee joint angle from different initial angle to same joint angle, and the effect of low load weight on its reproducibility.
Methods
Twelve subjects were participated in the experiment. Experiment was conducted in accordance with the Declaration of Helsinki. In the reproduction task, subjects were sit on the stable chair. Subjects were instructed to memory the target angle (5sec), and then reproduce their knee joint angle from initial angle to target angle. The target angle was set to 60°. The initial angles were set 30° and 90°. When the initial angle was 30°, subject perform their knee joint flexion (Flx). When the initial angle was 90°, subject perform their knee joint extension (Ext). In these conditions, subjects reproduced their knee joint angle with/without low load weight (4kg). Trial conducted five times in each condition.
Constant error (CE), Variable error (VE), and angle fluctuation (FL) during maintaining their matching angle were calculated. Two-way ANOVA by means of movement direction (extension/flexion) factor and weight force (non-weight/4kg) was conducted. Post hoc comparisons were made using Bonferoni; the threshold for statistical significance was set at $p<0.05$.
Results
CE and FL of Ext with 4kg weight showed significant higher than Flx with 4kg weight ($p<0.05$). VE of Ext showed significant higher than Flx ($p<0.05$), and VE was lower when 4kg weight was loaded ($p<0.05$).
Discussion
The CE showed negative value in all conditions. This suggested that the knee angle was more flexion position when subjects reproduced their knee angle. According to the result of VE, it was considered that the reproducibility of knee angle was decreased during knee flexion than knee extension. The error and fluctuation with 4kg weight condition was lower than non-weight condition suggested that an enhancement of perception was expected even low load weight, and increasing of afferent inputs from muscle spindle.
Contact
hayamit@shinshu-u.ac.jp

Neuromuscular Physiology

FORCE SENSE OF GYMNASTS AND NON-GYMNASTS IN THE ELBOW AND THE SHOULDER JOINTS

KOCHANOWICZ, A., NIESPODZINSKI, B.2, MIESZKOWSKI, J.2, SAWCZYN, S.1, KOCHANOWICZ, K.1
1: AWFIS (GDANSK, POLAND), 2: UKW (BYDGOSZCZ, POLAND)

Introduction
Muscle strength is one of the most important athletes' characteristics. However, much less attention is paid to the somatosensoric system that has a great impact on controlling strength. Gymnastics is a sport where athletes, apart from great muscle strength, also must exhibit excellent precision in muscle tension. Therefore, long-term gymnastic training should improve the ability of force sense in comparison to untrained adults, although there is a lack of information if such improvement could be joint-, muscle- or task-dependent.
Methods
In the study, 19 elite male artistic gymnasts (age: 20.6±3.3) and 20 untrained controls (age: 19.9±1.0) participated. All participants performed unilateral 5-second force match task for 20% and 50% of maximal isometric voluntary contraction (MVC) on Biodex System 4 dynamometer. The task evaluated contraction of flexors and extensors in the elbow and the shoulder joints. In the study, a relative error and a percentage of the total time below, inside and above the target force area (±5%) was measured. Two-way ANOVA of repeated measures (2 x 2) was used to evaluate the influence of gymnastic training (group) and muscle function (contraction) in the elbow and the shoulder joints.
Results
In terms of relative error, significant ($p<0.05$) interaction between group and contraction was notice only in elbow joint. For 20% of MVC, controls had higher relative error by flexors (3.6±1.4 %MVC) in comparison to extensors (2.3±1.7 %MVC), whereas gymnasts had same results independently of the contraction. Furthermore, controls underestimated force in comparison to gymnasts in this task. In case of 50% of MVC, untrained adults had higher relative error by extensors (7.7±5.7 %MVC vs 4.8±4.0 %MVC) which also underestimated the target force and their outcome was also higher in comparison to gymnasts extensors (4.1±3.0 %MVC).
Discussion
Unlike the ankle strength training outcome by Brendth et al. (2012), this study showed that long-term training can modify joint proprioception in terms of force sense. It must be noticed that gymnastic training beside strength training includes more activities stimulating proprioception. It is well documented in terms of the position sense in joints (Swanik et al., 2002). This study showed that gymnasts had better force sense which was contraction- and task-dependent. Because Christou et al. (2003) investigated different joints and loads, probably this is the first study to show a difference in reciprocal muscle groups.
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Contact
andrzejkochanowicz@o2.pl

ASSESSMENT OF MECHANICAL PROPERTIES AND ACTIVATION LEVEL IN SOLEUS MUSCLE WITH ELECTRICAL NERVE STIMULATION.

TSUNODA, N.1, ISOGAI, T.2, HIRATSUKA, K.1, AKIBA, S.1, SIMUNIC, B.3, DJORDJEVIC, S.3
1: KOKUSHIKAN UNIVERSITY (TOKYO, JAPAN), 2: TAKASAKI UNIVERSITY OF HEALTH AND WELFARE HIGH SCHOOL (GUNMA, JAPAN), 3: UNIVERSITY OF PRIMORSKA (KOPER, SLOVENIA)

Introduction
The tensiomyography (TMG) method can be applied for assessment of muscle mechanical properties of skeletal muscle. It is many reported that mechanical properties for contraction and stiffness are informed to sports and rehabilitation fields (Simunic, 2012). However,

mechanical properties with TMG method related to neuromuscular activation level by electrical nerve stimulation is not so reported. Therefore, the aim of this study was to examine the relations of muscle mechanical properties and M-wave as a neuromuscular activation level in human soleus muscle.
Methods
Subjects were 15 healthy male collegiate students of Physical education (age 20.8±2.2 years, height 173.0±6.2cm, weight 65.8±8.4kg). Tensiomyography (TMG method) was used to assess muscular response and mechanical characteristics in soleus muscle. Muscle contraction time (Tc) and maximal displacement of the muscle belly (Dm) were analyzed in all subjects (Dahmane et al., 2001). M-wave as a parameter for a neuromuscular activation was elicited by electrically stimulating the tibial nerve on the popliteal region. The rising phase time (Trp) and maximal amplitude (M-max) were analyzed by M-wave.
Results
Tc was showed close to Trp as a neuromuscular response（r=0.5388, p<0.05）. On the other hand, Dm as muscle stiffness had nothing to do with Trp. M-max, as a neuromuscular activation level, was significantly correlated to Dm(r= r=0.7255, p<0.05), whereas it was not correlated to Tc.
Discussion
In this study, it was found that the maximal displacement of muscle belly was affected by neuromuscular activation level. Also, muscle contraction time measured by TMG method was affected by rising phase time in M-wave. From these result, it was considered that mechanical properties assessed by TMG method reflected to the neuromuscular activation response and levels within the human soleus muscle.
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Contact
tsunoda@kokushikan.ac.jp

ARTIFICAL CO2-WATER FOOT BATH FACILITATE A RECOVERY FROM MUSCLE HARDNESS BY RESISTANCE EXERCISE

YAMAMOTO, N.1, TAKENOYA, F.2, WADA, T.3, HASHIMOTO, M.4
1JAPANESE RED CROSS HOKKAIDO COLLEGE OF NURSING, 2HOSHI UNIV., 3KOKUSHIKAN UNIV., 4TEIKYO. UNIV. SCI.

Introduction
Facilitation of the blood supply to the muscle and of oxygen consumption in the muscle by a local immersion of the extremities into high concentration carbon dioxide water (CO2-water, CO2≥1000ppm) (Yamamoto, 2007), suggests an improvement of muscle performance and joints flexibility. In the present study, we investigated whether the immersion of extremities including agonist muscles into artificially made high concentration CO2-water (CO2≥1000 ppm) influences recovery of muscle hardness in fatigue after resistance exercise.
Methods
The healthy male college students (n=11, age; 18-19 yrs, height; 168.6±4.5 cm, weight; 66.2±9.3 kg) participated in this study. The subjects performed 100 times calf raise resistance exercise and immersed lower legs into tap-water or artificial CO2-water at 35 °C for 10 minute after exercise. A laser blood flow in the immersed skin (BFskin) and electrocardiogram (ECG) were recorded continuously throughout the experiment. The medial head of gastrocnemius muscle (MG) dominant muscle hardness was evaluated using ultrasound real-time tissue elastography and visual analog scale in muscle (VAS) at pre-exercise, immediately exercise, after 10 min recovery. The strain ratio (SR) between the MG and a reference material was calculated.
Results
BFskin in the CO2-water foot bath was significantly higher than in the tap-water foot bath (CO2-water vs. tap-water, 5.5±1.8 vs. 2.1±1.2 ml·min-1·100g-1, p<0.05). After 10 min recovery, in the CO2-water foot bath compared with the tap-water, SR significantly decreased quicker (1.37±0.28 vs. 0.67±0.08, p<0.05). In addition, VAS after 10 min recovery became smaller in the CO2-water than the tap-water (18.1±10.2 vs. 33.9±16.2 mm, p<0.05).
Discussion
The previous study indicated that LF/HF ratio, an indicator of cardiac sympathetic nerve activity, was smaller in CO2-water immersion than in tap-water immersion (Sato, 2009). HR decrease in CO2-water immersion also suggests a suppression of sympathetic nervous system. We reported previously that the muscle blood flow in the immersed part was larger in CO2-water than tap-water of a same temperature. Muscular sympathetic activity might not be inhibited. The present study suggested that high concentration artificial CO2-water foot bath may contribute to rapid recovery from the high intensity exercise-induced muscle hardness.
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Contact
yama@rchokkaido-cn.ac.jp

AN INVESTIGATION INTO THE EFFECT OF MATCH-INDUCED NEUROMUSCULAR FATIGUE ON MALE COLLEGIATE BASKETBALL PLAYERS

CALLANAN, D.
INSTITUTE OF TECHNOLOGY CARLOW

Introduction
A competitive game of basketball has been reported to have a high eccentric demand (Montgomery et al., 2010), with athletes exposed to competition games every two to three days (Schelling et al., 2015). Therefore, it is crucial for coaches and sport science practioners to understand and implement methods of monitoring the existence, extent and the type of fatigue that players are exposed to (Beattie and Flanagan, 2015). The aim of this study was to investigate the effect of match-induced neuromuscular fatigue (NF) on male collegiate basketball players, using the reactive strength index (RSI).
Methods

Nine male collegiate basketball players participated in this study. The first day of testing was to identify the optimal drop jump (DJ) height for all participants. After a baseline score was obtained, two DJs were performed immediately after a collegiate basketball game, 24 hours, 48 hours and 72 hours post game. RSI was calculated using the jump height (JH) and the ground contact time (CT).
Results
There was a significant difference reported in RSI between baseline, post match, 24 h and 48 h post match (1.55 ± 0.44 vs. 1.23 ± 0.31 and 1.08 ± 0.25 and 1.30 ± 0.37 mm.ms-1), respectively ($p < 0.05$). There was a significant difference observed between baseline, 24 hours and 48 hours in JH (31.22 ± 8.27 vs. 26.76 ± 6.76 and 26.72 ± 7.41 cm), respectively ($p < 0.05$). There was no significant difference to report in CT between any time periods investigated ($p > 0.005$).
Discussion
On reviewing the findings, it can be concluded that it was JH that resulted in the significant difference reported in RSI scores, concluding that an athlete's neuromuscular system is significantly affected for up to 48 hours after a collegiate basketball match. The greatest effect was reported at 24 hours post match as expected. It is paramount that athletes are monitored (Oliver et al., 2015) as fatigue accumulation can result in overtraining, injuries and a decline in performance (Chatzinikolaou et al., 2014). By simply implementing a measure of NF, coaches can implement individualised changes to training sessions when necessary. Based on these current findings it is important that the variables within the RSI formula be considered on their own merits.
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Contact
Dannicallanan93@gmail.com

Nutrition

EFFECT OF VOLUNTARY DRINKING BEHAVIOR ON FLUID BALANCE AND SPRINT PERFORMANCE IN COLLEGE SOCCER PLAYERS

SUN, F.H., SI, G.Y., LI, C., KAM, W.K.
THE EDUCATION UNIVERSITY OF HONG KONG

Introduction
Dehydration is often observed in soccer, which will potentially decrease performance. However, little studies were conducted to investigate whether the voluntary drinking behavior will be affected by different available solutions. The purpose of the proposed study was to investigate whether the voluntary drinking volume will be different and whether these will affect fluid balance and sprint performance, when college soccer players were provided with three different solutions, i.e. carbohydrate-electrolyte solution (CES), sweetened non-caloric electrolyte solution (SES), and distilled water (DW).
Methods
Nine college soccer players (4 females and 5 males) volunteered to participate in this study. They completed three main trials in a cross-over study design, separated by at least 7 days. In each main trial, they completed 90 minutes of regular training, followed by one repeated sprint test (RST). One of the three different solutions was provided to the participants before each main trial. The participants were instructed to drink whenever they want. The drinking volume (DV) of each solution was recorded. One sensory questionnaire was used to evaluate the feelings of participants on each solution before the main trials. The body mass (BM) and urine specific gravity (USG) were recorded before and after each main trial. Blood glucose and lactate concentrations were measured before and after regular training, as well as after RST.
Results
The DV was lower in SES trial than the other two trials (553±82 vs. 919 ±85 & 1010±96 ml, SES vs. CES & DW, $p<0.01$). The BM decreased in all three main trials, whereas no differences were found in change of BM among three trials (0.72±0.65 vs. 1.44 ±0.59 vs. 0.41±0.31 kg, CES vs. SES vs. DW, $p>0.05$). The changes of USG is larger in SES trial than the other two trials (0.0108±0.0040 vs. -0.0129±0.0020 & -0.0032±0.0030, SES vs. CES & DW, $p<0.05$). Blood glucose concentration was higher in CES trial than the other two trails after RST (7.25±0.72 vs. 6.55±0.64 & 6.38±0.50 mmol/L, CES vs. SES & DW, $p<0.05$). The average performance in RST is better in SES trial than the other two trials (5.05±0.10 vs. 5.74±0.11 & 5.93±0.19 s, SES vs. CES & DW, $p<0.05$). However, the fatigue index is higher in DW trial than the other two trials (21.1±1.7% vs. 14.3±1.7% & 14.9±1.2%, DW vs. CES & SES, $p<0.01$).
Discussion
In conclusion, it seems that both CES and SES have certain benefits in sprint performance for college soccer players, compared with DW. However, when provided ad libitum, they have no significant influences on fluid balance, although the drinking volumes are different.

ORAL CAPSINOIDS SUPPLEMENTATION CANNOT ENHANCE GLYCOGEN RECOVERY IN EXERCISED HUMAN SKELETAL MUSCLE

CHENG, I.S.1, YEH, F.Y.1, CHEN, J.C.1
1.NATIONAL TAICHUNG UNIVERSITY OF EDUCATION

Introduction
Capsinoids (CSN), non-pungent capsaicin analogs, are extracted from non-pungent type of red pepper, which increase energy expenditure like capsaicin via activation of a cation channel, transient receptor potential cation channel vanilloid subfamily 1 (TRPV1) in rat model (Kawabata et al., 2009; Morita et al., 2006). Capsinoids have been reported to enhance the energy expenditure, fat oxidation and insulin action in mice and humans. However, the mechanism behind CSN effects on metabolic consequences in human skeletal muscle remains unclear.
Methods
Nine male athletes completed a single blind and crossover designed study. A single bout of 60-min cycling exercise at 70 % (VO2 max) was performed and subjects consumed a normal diet (60% carbohydrate, 25 % fat, 15% protein) with CSN (12 mg, single dosage) and

placebo immediately after exercise. Biopsied muscle samples were obtained from the vastus lateralis immediately (0h) and 3h after exercise. Simultaneously, blood samples and expired gas analysis were collected before and after exercise.
Results
The result from our study demonstrated that oral CSN supplementation immediately after exercise was unable to enhance the glycogen resynthesis in exercised human skeletal muscle. However, CSN supplementation could alter the energy reliance on fat oxidation during the post-exercise period, based on gaseous exchange measurement. There was no significant response of P-Akt/Akt ratio following a single bout of exercise with CSN supplementation. However, the GLUT4 response was significantly elevated in CSN trial that is inconsistent with glycogen resynthesis in exercised human skeletal muscle.
Discussion
Our study provided evidence that acute oral capsinoids supplementation is able to change energy reliance on fat oxidation in exercised young athletes. However, these metabolic consequences cannot in turn to increase the muscle glycogen resynthesis during 3h post-exercise recovery period following a carbohydrate meal. Biopsied data from vastus lateralis showed that capsinoids increased the muscle GLUT4 protein expression 3-h after exercise without affecting muscle glycogen levels. On the other hand, no significant difference on P-Akt expression was observed at 0 h and 3 h between capsinoids and placebo trials. These available evidences suggest further investigations may necessary to confirm the ergogenic properties of capsinoids in connections with muscle glycogen recovery in exercised human.
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Contact
ischeng1965@mail.ntcu.edu.tw
ischeng1965@ntcu.edu.tw

EFFECT OF CHRONIC DIETARY NITRATE SUPPLEMENTATION ON TIME TO EXHAUSTION AND TOTAL WORK DURING ALL-OUT UPPER BODY RESISTIVE EXERCISE

RAMSBOTTOM, R., MOSS, H., VARNHAM, R.
OXFORD BROOKES UNIVERSITY

Introduction
Earlier work has shown dietary inorganic nitrate (NO3-) supplementation can enhance work efficiency and time to exhaustion during intense exercise (Bailey et al., 2015), together with increased knee extensor speed and power (Coggan et al., 2014). However, there is little evidence to show whether NO3- supplementation improves performance during dynamic upper body exercise to exhaustion.
Methods
Nine men, age 20.5±0.7 years; height 1.80±0.08 m; body mass 80.8±10.9 kg, consented to participate in a randomized, double-blind cross-over study, which had University ethical approval. Diet was replicated between trials and foods high in nitrate avoided. After familiarization, participants returned to the laboratory on two occasions (separated by 7-10 days), during which they were instructed to perform bench press exercise (Smith machine) at 40% 1RM (one repetition maximum; 30.8± 6.9 kg) and to continue the protocol to maximal volitional exhaustion. Prior to the two experimental visits participants consumed either beetroot juice (BRJ) (13 mmol NO3-) (Beet It Sport, James White Drinks, UK) or placebo (PLB) (cornflour, 0.4 g kg-1 body mass d-1) for three days prior to testing. Participants were informed that they were to receive either BRJ or bicarbonate, both of which have demonstrated ergogenic effects, or the equivalent PLB. Blood pressure (BP) was measured using an automated sphygmomanometer (Dinamap 400 ProV) at familiarization and at the same time after chronic ingestion (BRJ/PLB) before exercise. Bench press performance was assessed from video analysis (30Hz) for time to exhaustion and total work (kJ). Student's t-test was used to identify differences between BRJ and PLB and a one-way ANOVA for BP (SPSS version 22).
Results
Three days supplementation with dietary inorganic NO3- significantly lowered systolic BP (115±10/75±7) compared with PLB (119±11/78±6 mmHg) ($p<0.05$). There was an increase in time to exhaustion (48.1 ± 4.0 vs. 42.4 ± 5.7 s, BRJ vs. PLB respectively, $p<0.05$), and total work BRJ (12.0 ± 1.5) vs. PLB (10.3 ± 1.9 kJ) ($p<0.05$).
Conclusion
The results of the present study show increased time to exhaustion with chronic BRJ supplementation during all-out, upper body dynamic exercise, together with increased total work, possibly due to improved local muscle perfusion and oxygenation.
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Contact
rramsbottom@brookes.ac.uk

EFFECTS OF 50 DAYS OVOMET® SUPPLEMENTATION ON ACHILLES TENDON STIFFNESS AND SUBJECTIVE PAIN PERCEPTION AMONG CROSSFIT ATHLETES.

SETUAIN, I.1,2, JAUREGUI, L.1, GARCIA-TABAR, I.1, GARCIA, I., LEOZ, I.1, LOPEZ SAEZ DE ASTEASU, M.1, AGUIRRE GONZÁLEZ, A.3, GIL-QUINTANA, E.3, IZQUIERDO, M.1
1PUBLIC UNIVERSITY OF NAVARRA 2TDN. ORTHOPEDIC SURGERY AND ADVANCED REHABILITATION CENTRE. CLINICAL RESEARCH DEPARTMENT. SPAIN 3 EGGNOVO S.L., NAVARRE, SPAIN

Introduction
The use of eggshell membrane supplementation has risen in the recent years in order to alleviate joint and/or tendon pain conditions with favorable patient reported subjective scores.
Objective
To examine the effects of 50 days ovomet® (eggshell membrane) supplementation among crossfit athletes on pain relief using different questionnaires and a pilot study of the effect of ovomet® on Achilles tendon linear stiffness.

Methods
A preliminary double-blinded randomized controlled study, among 22 men and women (mean ± SD 33 ± 7 years; 175 ± 8.9 cm and 82.4 ± 17.3 kg.) (control n=13 and intervention n=9 subjects) crossfit athletes without injury, in training stable period, not allergic to egg and with a previous washout was carried out. Participants completed the WOMAC and DASH questionnaires before and after 50 days of placebo or ovomet® supplementation (a daily capsule containing 300 mg, OVOMET® Health, Eggnovo S.L Spain).
Results
The questionnaires (WOMAC and DASH) before and after the administration of ovomet® showed a pain relief in lower joints of 91.4% +/- 4.82 for supplemented subjects vs 45.93% +/- 14.11 for controls; a reduction in the perceived stiffness of 53.33% +/- 13.37 in the supplemented vs 39.05% +/- 20.14 in the control group; as well as a decrease in the perceived functional limitation of upper joints of 19.04% +/- 0.69 for de supplemented group vs 11.1% +/- 5.22 for the control group.
Conclusions:
Ovomet® reduces the perception of pain and stiffness on tendons and/or joints according to the results of the WOMAC and DASH questionnaires on 50 days. In the basis of the promising results obtained, further research with more population could give more insights in relation to the effectiveness of eggshell membrane supplementation in order to alleviate chronic tendon and or joint pain conditions.
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EFFECTS OF PROTEIN SUPPLEMENT COMBINED WITH RESISTANCE EXERCISE ON LEAN MASS AND FUNCTION OUTCOME IN ELDERLY INDIVIDUALS_A SYSTEMIC REVIEW AND META-ANALYSIS

LIAO, C.D., TSAUO, J.Y., LIOU, T.H.
SHUANG HO HOSPITAL, TAIPEI MEDICAL UNIVERSITY, TAIWAN

Introduction
Sarcopenic obesity has been characterized as simultaneously suffering low muscle mass and high body fat, which can be effectively improved by resistance exercise training (RET). Nutrient supply, such as protein supplement (PS), has been recommended for additional lean mass and strength regain in individuals receiving RET or in obese elderly individuals with energy restricted diet. Whether PS during RET exert any benefit on augmentation of muscular and functional performance in obesed elder people remains unclear. The purpose of this study was to identify the effect of PS in combination with resistance exercise on body composition and physical function for elder people with sarcopenic obesity.
Methods
A comprehensive search of online database including Medline, PUBMED, EMBASE, and Google Scholar databases was performed to identify randomized controlled trials (RCT) that reported the efficacy of PS on lean mass gain, strength gain, and physical mobility in obesed elder individuals with RET.
Results
Sixteen RCTs were included in the analysis. Nine trials had excellent methodological quality with a PEDro score≧9, whereas seven ones had a PEDro score＜9. Participants with additional PS had significantly greater gain in lean mass with a standard mean difference (SMD) of 0.58 (95% CI 0.30, 0.86; $p < 0.0001$; $I2 = 70\%$, $p < 0.0001$); and in leg strength with a SMD of 0.71 (95% CI 0.37, 1.04; $p < 0.0001$; $I2 = 59\%$, $p = 0.009$).
Conclusions
Additional PS in combination with RET is effective for eliciting gains in lean body mass, appendicular or leg lean mass, and muscle strength, except a parallel gain in physical mobility or physical capacity, in obese elder adults. Clinicians should incorporate strategies for improving physical activity into their management of patients with sarcopenic obesity to maximize health status, especially for elder individuals who are overweight or obese.

EFFECT OF DEHYDROEPIANDROSTERONE SUPPLEMENT COMBINED WITH WEIGHT-LOADING WHOLE-BODY VIBRATION TRAINING ON EXERCISE PERFORMANCE AND BIOCHEMICAL PROFILES IN MIDDLE-AGED MICE

CHEN , W.C., CHEN, Y.M., HUANG, C.C.
CHANG GUNG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Introduction
Resistance exercise increases muscle mass, function in older adults. Whole-body vibration (WBV) is a well-known kind of light-resistance exercise and convenient exercise for older adults. We combination with resistance exercise and WBV to weight-loading whole-body vibration (WWBV) training. Dehydroepiandrosterone (DHEA) is secreted primarily by the adrenal gland and is the most abundant sex steroid. However, the previous study showed that WBV combination with DHEA could not improve exercise performance and reduce fatigue-relative profile in young mice model. After that, we modified our training program which integrated the WBV and resistance training. We also combined DHEA supplementation to demonstrated body composition, exercise performance, and fatigue in middle-aged mice. The objective of the study is to investigate the beneficial effects of WWBV training and DHEA supplementation on body composition, exercise performance, and physical fatigue-related and biochemical responses in middle age C57BL/6 mice. In this study, we design the WWBV program in animal model, and combination of DHEA supplements whether a synergistic effect during WWBV and enhance C57BL/6 middle age mice exercise performance and resistance to fatigue for our experiments.
Methods
9-mounth old Male C57BL/6 mice were randomly divided into 4 groups: Sedentary control group with vehicle (SD), DHEA supplementation (5 mg/kg, DHEA) group, WBV group+ DHEA supplementation (5 mg/kg, WBV+DHEA) group and WWBV with DHEA supplementation group (5 mg/kg, WWBV+DHEA) for 6 weeks and followed by 6 weeks WBV and WWBV of 5 days per week. Exercise performance was evaluated by forelimb grip strength and exhaustive swimming time as well as by changes in body composition and anti-fatigue activity levels of serum lactate, ammonia, glucose, and creatine kinase (CK) after a 15-min swimming exercise. The biochemical parameters were at the end of the experiment.
Results

In our study, although mice supplementation of DHEA increase the serum testosterone, muscle strength, endurance exercise performance and have anti-fatigue activity; WWBV+DHEA training could have more affective in endurance exercise performance, anti-fatigue activity and decrease white adipose tissue compared with DHEA supplemented. However, DHEA supplement combined with WWBV training could improve exercise performance and ameliorate fatigue and prevent senescence-associated biochemical and pathological alterations in middle-aged mice.
Conclusion
In the result we find DHEA can enhance the serum testosterone, exercise performance and have anti-fatigue activity and WWBV+DHEA also can improve performance and have anti-fatigue activity especially in endurance exercise and decrease white adipose tissue. We inference that resistance training of training program are the key point to prevent aging activity. Above all, WWBV may be an effective intervention for health promotion in the aging population.

THE RELATIONSHIP BETWEEN MUSCULOSKELETAL AMBULATION DISABILITY SYMPTOM COMPLEX AND DIETARY HABITS IN COMMUNIY-DWELLING ELDERLY WOMEN

OHKI, K., HIISATOMII, M., KIMURA, Y., KAWAI, J.
SUGIYAMA JOGAKUEN UNIVERSITY

Introduction
Regular physical activity is essential to better health and wellness. However, falls must be prevented, because they are prone to losing their balance during physical activities. Recent research has shown that older people who perform poorly on standardized tests of lower extremity strength and balance are at a higher risk of developing disabilities. It is well known that balance ability is one of the items of muscleskeletal ambulation disability symptom complex (MADS). Dietary habits also important factor in our heathy life. The aim of this study is to clarify the relationship between of MADS and dietary habits in Japanease community-dwelling elderly people.
Methods
Sixty-five local elderly women residents aged 65 yrs. or older were recruited. The subjects were divided into two groups: 1) one-leg standing time with eyes open for more than 15 sec. (high-level group; n=46, HG) , 2) one-leg standing time with eyes open for less than 15 sec. (low-level group: n=19, LG). Hand-grip strength, chair-stand test, functional reach test (FR), time up go test, 10-m maximal walking speed (MWS), mini-mental state examination (MMSE), trail making test (TMT), fall efficacy scale (FES), psychological functions and brief-type self-administered diet history questionnaire (BDHQ) were compared.
Results
As the results, one-leg standing time with eyes open was 59.5+43.9 sec., and HG subjects, accounted for 70.7% of the total subjects. Significant differences ($p<0.05$) were observed in the age (HG;71.5+4.2, LG;74.3+4.4 yrs.), hand-grip strength (HG;29.6+6.2, LG;24.8+5.6 kg), FR (HG;79.6+8.2, LG;61.2+18.0 cm), MWS (HG;2.0+0.2, LG;1.8+0.2 m/sec.), MMSE (HG;28.5+1.9, LG;26.7+3.2 pts.) and FES (HG;37.6+3.9, LG;32.7+4.5 pts.) between the two groups. The results of BDHQ revealed that fish and shellfish intake (HG;60.1+43.3g, LG;10.6+3.5 g, $p<0.01$) were associated with physical function and MADS. When comparing the two groups after adjusting for age, a significant difference ($p<0.05$) was observed only in TMT (HG;92.2+22.0, LG;128.8+56.2 sec).
Conclusion
It was suggested that the elderly women with lower level of balance ability and lower frequency of eating fish and shellfish were markedly influenced to their healthy life.

EFFECTS OF 10 WEEKS OF STRENGTH TRAINING COMBINED WITH ANTIOXIDANTS SUPLLEMENTATION ON MUSCULAR PERFORMANCE

ÁLEX, S.1, DUTRA, M.1, SILVA, A.1, MARTORELLI, A.1, CLETO, V.1, FONSECA, A.1, ESPÍRITO SANTO, F.1, SILVA, R.2, BOTTARO, M.1
1: UNB (BRASÍLIA, BRAZIL), 2: UFOP (OURO PRETO, BRAZIL)

Introduction
Strength training (ST) is known to promote adaptations that result in health benefits. It is argued that the oxidative stress coming from a ST session may play a positive role in the adaptations to chronic training (Powers et al., 2010). Therefore, few studies investigated the effects of ST combined with antioxidants supplementation on muscle performance (Paulsen et al., 2014). However, their results are still controversial. Thus, the aim of this study was to investigate the effects of ST combined with antioxidant supplementation on muscular performance.
Methods
Thirty-three untrained women (22.9±2.5 years, 57.7±8.4 kg, 1.6±0.6 m) were allocated into three groups: Vitamins (VG, n=12), Placebo (PG, n=11) and Control (CG, n=10). Participants of VG and PG underwent a lower-body periodized ST, two-times a week, for 10 weeks. VG group supplemented with vitamin C (1g/day) and E (400IU/day) during the training period. Knee extensor peak torque (PT), total work (TW) and muscle fatigue (MF) were measured using an isokinetic dynamometer (Biodex System IV). All analyses were performed using a SPSS.
Results
There were no differences between groups on PT and MF after training. However, only PG increased PT (146.0±27.6 vs 156.1±31.0N.m, $p<.05$) when compared to pre-training. Moreover, VG presented greater MF after training (36.8±10.4 vs 43.2±6.9%, $p<.05$). PG performed greater TW when compared to VG and CG after ST period ($p<.05$). In addition, both VG (1981.6±376.3 vs 2099.9±339.2 J) and PG (1904.3±346.9 vs 2180.2±432.6 J) showed greater TW after 10 weeks when compared to pre-training ($p<.05$).
Discussion
The results of the present study is in line with a previous studies that reported lower strength gains in the supplemented group in young people (Paulsen et al., 2014). However, Bobeuf et al. (2011) and Bjornsen et al. (2015) reported no differences between supplemented and non-supplemented groups. There is evidence that free radicals contribute to MF (Powers & Jackson, 2008). Yet, contrary to what could be hypothesized, MF showed to be augmented only in VG after 10 weeks, whereas PG performed greater TW when compared to VG and CG. Thus, the results of this investigation suggest that chronic antioxidant vitamins supplementation may mitigate improvements in muscular performance.
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Contact
savioalex@outlook.com

EFFECTS OF NATURAL SUPPLEMENTATION WITH POLYPHENOLS ON OXIDATION CAPACITY OF FAT-BASED SUBSTRATES AND VO2MAX

MARÍN-PAGÁN, C., CASES, J., ROMAIN, C., CARLOS-VIVAS, J., RAMOS-CAMPO D.J., O´SULLIVAN, R., GAILLET, S., LAURENT, C., MARTÍNEZ-NOGUERA, F.J., MARÍN-CASCALES, E., FREITAS, T.T., ALCARAZ, P., CHUNG, L.

CATHOLIC UNIVERSITY OF MURCIA

Introduction
Increased lipid oxidation and conservation of carbohydrates reserves help optimize performance during prolonged physical activity (1-2). Commonly found supplementations with caffeine, vitamins, and creatine, all of which have been shown to increase lipid metabolism during exercise (3). The aim of the present clinical study was to explore the effect of 8-wks of aerobic training with chronic supplementation on VO2max and its contribution on lipid oxidation for aerobic energy.
Methods
20 recreationally-active males (20–35 yrs) trained on a cycloergometer for 8-wks at their FatMax intensity with the supplementation BurntoRun® (BRG=12) or a placebo product (PG=8). FatMax and VO2max test was performed using a gas analyser and measured before and after training. BurntoRun® supplements contained polyphenols from flavanones as well as from methylxanthines family, while the placebo consisted of 100% maltodextrin (both in 500mg capsules). On days without exercise, participants took 2 capsules at breakfast and 2 before lunch. On training days (3/wk) 4 capsules were ingested 60´ before the exercise session. At weeks 4, 6 and 8, the intensity level was increased by increments of 2% VO2max. Changes within and between both groups were analysed using paired and unpaired Student's t-test. Statistical significance was set at $p<0.05$ and $p<0.10$ for trend to significant.
Results
FatMax in BRG tended to increase by 28±50% ($p=0.098$) while no changes were found in PG (21±75%; $p=0.135$). VO2max increased significantly in the BRG (6.0±7.0 %; $p=0.002$) but not in the PG (0.9±8.3 %; $p=0.377$).
Discussion
FatMax was observed between 35-40% of VO2max, which are lower than previous studies that have shown FatMax closer to 60% (4). Other studies have demonstrated that the ingestion of CHO before exercise may reduce the rate of fat oxidation in the subsequent exercise period (5). BRG increases in VO2max by 5.1% more than PG. Similarly, a previous pilot clinical investigation demonstrated that supplementation with a pure polyphenol compound (quercetin, 500mg twice daily) increased VO2max by 3.9% (6). BurntoRun® can provide added benefits to aerobic training by improving metabolic pathways implicated in aerobic performance.
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Contact
cmarin@ucam.edu

SUPPLEMENTATION WITH A POLYPHENOL-RICH EXTRACT, PERFLOAD®, IMPROVES PHYSICAL PERFORMANCE DURING HIGH-INTENSITY EXERCISE

MARÍN-CASCALES, E., CASES, J., ROMAIN, C., MARÍN-PAGÁN, C., FREITAS, T., CHUNG, L., RUBIO-ARIAS, J., RUBIO-PÉREZ, J., MARTÍNEZ-NOGUERA, F., CARLOS-VIVAS, J., LAURENT, C., GAILLET, S., PROST-CAMUS, E.

CATHOLIC UNIVERSITY OF MURCIA; FYTEXIA; UNIVERSITÉ DE MONTPELLIER; LABORATOIRES SPIRAL.

Introduction
Workout capacity is determined by the ability to synchronise interactions between the cardiovascular, respiratory, skeletal-muscular and nervous systems (1). When high peak power (PP) outputs are to be achieved, the organism relies more on the anaerobic metabolism; as an adaptive response, the exerting muscles prioritise two pathways of stored energy, both accessible without oxygen: the phosphagen system and anaerobic glycolysis (2). The aim of the study was to evaluate if an innovative polyphenol-based food supplement, PerfLoad®, was able to improve PP output and average power (AP) developed during high-intensity anaerobic exercise.
Methods
Fifteen healthy recreationally-active male volunteers (22.2±2.2 yrs) participated in a randomized, double-blind, crossover clinical investigation. Participants were randomly assigned to one of 2 groups, supplementation or placebo, and completed 3 training sessions consisting of 4x30s all out Wingate tests on day 1, 4 and 21 of the investigation. After a 5-wk wash-out period, each volunteer was switched to the other supplementation group for a second investigation period. The primary outcomes were PP and AP output during the first 30s sprint.
Results
PP of the supplemented subjects significantly improved by 3.7% ($p=0.048$), compared to those who received the placebo (761±92.1 vs 734±104.7 W). AP was significantly enhanced by 5.0% with the supplement ($p=0.025$; 615±75.4 vs 586±78.9 W).
Discussion
PerfLoad® supplementation is able to rapidly and significantly increase performance during an intense anaerobic effort. PP improved by 27 W and AP produced was enhanced by 29 W. To reach comparable performances, athletes usually have to undergo very specific physical training and/or be supplemented with synthetic aids (3, 4).
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Contact
emarin@ucam.edu.

IS THERE A CHRONIC ELEVATION IN ORGAN-TISSUE SLEEPING METABOLIC RATE IN VERY FIT RUNNERS?

MIDORIKAWA, T., TANAKA, S., ANDO, T., TANAKA, C., KONISHI, M., OHTA, M., TORII, S., SAKAMOTO, S.
J.F. OBERLIN UNIVERSITY

Introduction
It is unclear whether the resting metabolic rate of individual organ-tissue in adults with high aerobic fitness is higher than that in untrained adults; in fact, this topic has been debated for years using a 2-component model. To address this issue, in the present study, we examined the relationship between the measured sleeping energy expenditure (EE) by using an indirect human calorimeter (IHC) and the calculated resting EE (REE) from organ-tissue mass using magnetic resonance imaging, along with the assumed metabolic rate constants in healthy adults.
Methods
Seventeen healthy male long-distance runners were recruited and grouped according to the median VO2peak: very fit group (>60 ml/min/kg; n = 8) and fit group (<60 ml/min/kg; n = 9). Participants performed a graded exercise test for determining VO2peak; X-ray absorptiometry and magnetic resonance imaging were used to determine organ-tissue mass, and IHC was used to determine sleeping EE. The calculated REE was estimated as the sum of individual organ-tissue masses multiplied by their metabolic rate constants.
Results
No significant difference was observed in the measured sleeping EE, calculated REE, and their difference, as well as in the slopes and intercepts of the 2 regression lines between the groups. Moreover, no significant correlation between VO2peak and the difference in measured sleeping EE and calculated REE was observed for all subjects.
Conclusion
These results suggest that aerobic endurance training does not result in a chronic elevation in the organ-tissue metabolic rate in cases with VO2peak of approximately 60 ml/min/kg.

EFFECT OF BETA-ALANINE SUPPLEMENTATION ON METABOLIC CONTRIBUTION AND PERFORMANCE IN SWIMMING

BARBIERI, R.A.1,2, GOBBI, R.B.1.2, CAMPOS, E.Z.2,3, BERTUCCI, D.1, NORBERTO, M.2, ZAGATTO, A.M.1, PAPOTI, M.1,2
1- UNESP (BAURU, BRAZIL), 2- EEFERP-USP (RIBEIRÃO PRETO, BRAZIL), 3 - UFPE (RECIFE, BRAZIL).

Introduction
Nutritional strategies can be capable of increasing muscle-buffering capacity and attenuating the increase in [H+] during high-intensity exercise and might increase performance. A promisor buffering is the carnosine, which is a buffering with intramuscular function, and the carnosine synthesis is clearly limited by offer of beta-alanine (BA). The aim of this study was to analyze the effects of BA supplementation on metabolic participation, performance in 400m-effort and force parameters in swimming.
Methods
Thirteen competitive swimmers, underwent a 6 week, double blind controlled study consuming 4.8g of BA or placebo (PLA). Before and after the 6 week period, a 400-m maximal bout, to determine metabolic contributions, and a 30s all-out in tethered swimming to access force parameters was conducted. Total energy demand was calculated through the product between VO2peak obtained at the end of 400 m and time. Anaerobic alactic energy was assumed as the fast component of excess post-oxygen consumption and lactic energy was determined by net lactate accumulation. Aerobic contribution was determined by the difference between total energetic demand and anaerobic contribution.
Results
Peak force (BA: 210.11 ± 44.6N; PLA: 230.3 ± 47.7N), mean force (BA: 103.26 ± 23.6 N; PLA: 106.3 ± 33.1N) and 400m performance (BA: 289.24 ± 21s; PLA: 292.17 ± 24.2s) presented no significant difference between pre and post supplementation. Significant differences were found ($p<0.05$) between moment pre and post on the variables: blood lactate peak concentration (BA: 8,01 ± 2,4mM; PLA: 9.46 ± 3.3mM), , VO2peak (BA: 3.78 ± 0.8L•min-1; PLA: 3.8 ± 1L min-1), VO2rest(BA: 0,51 ± 0,07L•min-1; PLA: 0,54 ± 0,13L•min-1), anaerobic lactic contribution (BA: 1,7 ± 0,7 L; PLA: 2,12 ± 0,95L), anaerobic alactic contribution (BA: 1,17 ± 0,64 L; PLA: 1,58 ± 0,83L).
Discussion
Our results showed that BA supplementation was not capable to induce significant changes in metabolic participation during 400-m effort. However, the most important aspect of knowledge about metabolic demand is precisely the relative contribution of the energy systems to the total energy for a given physical exercise (Artioli et al. 2012; Damasceno et al. 2015). This method can be adapted to exercises and sports with different characteristics (i.e. judo) (Artioli et al. 2012). In addition, this method is used to change some paradigms about metabolic contribution (Damasceno et al. 2015).
Conclusion
BA supplementation does not present any significant changes in metabolic participation and performance.
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Contact
mpapoti@yahoo.com.br

Philosophy and Ethics

SPORT CULTURES IN TRADITIONAL KOREAN ART

KIM, H.
DONG-EUI UNIV

Sports cultures have been observed throughout history in many art works created by a variety of forming methods, and are being expressed in various forms even today. These art works have been used to meet some needs in the field of sport cultures, on the other hand, new discoveries of unique formativeness in the sport cultures have led to development of new art cultures.
Now, let's take a look at the characteristics of Korean art. Especially in the Joseon dynasty. Joseon set a policy to 'oppress Buddhism and admire Confucianism' as their guiding ideology. So, in this environment flourished paintings that showed a practical culture and simplicity. Based on this context, we will look into the characteristics and changes of various forms of sports cultures in Korean art, and also see what contents can have historical values attracting us within their artistic spectrums. For example kim hong do painting. It is a late 19th century work, drawn on a paper in light color (27.0×22.7㎝), describing a Korean traditional wrestling called Ssireum. It depicts a specific technique in Ssireum, known as duijibgi (a move similar to back-drop). It shows the moment where the player focuses on making his move, excited crowd having fun and making noise, some showing resentment etc. The picture is very detailed as you can see the concession standing there pretending he is not part of the scene, humorous expression of various characters, the anticipation of victory and defeat, detailed facial expression of cheers and sadness, and the chaotic scene altogether. It shows well the plot of the scene by describing the psychological side of each player, their facial expression and the tension between them, and their composition of confrontation. By depicting how hard they grab each other's cloth in detail, it expresses the traditional wrestling scene in light-colored India ink style, along with the various description of people's faces. It expresses clearly the natural fringe of the human body, the harmony of the human body and the harmony of the cloth.
In conclusion, these art works show the change of sport cultures in Korean traditional art field, attractiveness and differentiated brand to positively capture the value of the new era. It is considered that this will also be a stepping stone to provide elegance of art culture including artistic value along with the differentiated contents related to sports. We will be able to develop arts and sports by studying various aspects in relation with these three works, and these efforts will provide a chance to raise the high-level of sports spirit and self-esteem for art culture.

Physical Education and Pedagogics

MEASURING STUDENT MORAL DISENGAGEMENT IN PHYSICAL EDUCATION

HSU, W.T.
FO GUANG UNIVERSITY

Background
In the context of physical education, some misbehaviors such as shirking, skipping class, idleness, disrespect, fighting, or even bullying impedes the teaching of the educators and the learning efficacy of peers.
Purpose
This study aimed to develop a moral disengagement scale specifically in physical education context.
Method
We established the items through interviews and examined the validity and reliability with a two-phased quantitative study.
Results
The moral disengagement in physical education scale (MDPES) comprises five factors: conduct reconstrual, advantageous comparison, nonresponsibility, distortion of consequences, and attribution of blame – with a total of 17 items.
Conclusion
The study provided preliminary support for the validity and reliability of these 17 items, a five-factor MDPES. However, future studies should further test and prove the validity of the MDPES with diverse samples.

THE INFLUENCE OF INTEGRATION OF COMPETENCE SUPPORTED-STRATEGY INTO THE TEACHING PERSONAL AND SOCIAL RESPONSIBILITY MODEL IN PHYSICAL EDUCATION

CHEN, T.T., HSU, W.T.
YUANPEI UNIVERSITY OF MEDICAL TECHNOLOGY

Introduction
The teaching personal and social responsibility (TPSR) proposed by Hellison is currently one of the mainstream model in sport pedagogy study. It emphasizes positive learning environment developing by satisfying competence, autonomy, and relatedness, the three basic psychological needs, based on the self-determination theory (SDT). In our previous study, the students in TPSR model showed higher satisfaction on relatedness and autonomy but no significant difference on competence. However, competence is one of the effective predictive factors on the responsibility development of students in physical education. Therefore, we suppose the competence supported-strategy could complement the TPSR, and the integration could help students' responsibility development.
Purpose
The study aims to examine the effects of competence supported-strategy which was integrated into TPSR on students' responsibility.
Methods
The participants were high school students in Taiwan. The experimental group (37 students) was the class participating competence supported-strategy integrated into TPSR physical education while control group A (38 students) received TPSR-implemented PE classes and control group B (41 students) received regular PE classes without any intervention. Pre-test was made on the first week and post-test was made on the 18th week. The actual experimental duration was 16 weeks. The measurement for both pre-test and post-test was the students' responsibility in physical education scale (SRIPES).
Results

MACOVA showed the main effect was significant (Wilk's Λ = .60, F (12, 204) = 20.31, p < .05, η 2 = .54). The between-subject effects suggested significant results in effort (F (1, 107) = 20.38, p < .05, η 2 = .32), self-direction (F (1, 107) = 82.51, p < .05, η 2 = .44), following class rules (F (1, 107) = 99.92, p < .05, η 2 = .57), respect (F (1, 107) =70.38, p < .05, η 2 = .40), helping (F (1, 107) =57.48, p < .05, η 2 = .35) and cooperation (F (1, 107) =94.05, p < .05, η 2 = .47). The results indicated the scores of experimental group and control group A were all significantly higher than control group B on effort, self-direction, following class rules, respect, helping and cooperation. Moreover, the scores of experimental group were significantly higher on effort, self-direction and following class rules than control group A while there was no significant difference on respect, helping and cooperation.

Discussion

Due to the absence of connection between competence support and TPSR in our previous study results, this study showed that integrating competence supported-strategy into TPSR can enhance students' effort, self-direction, and following class rules than TPSR only. However, there were no significant effects on respect, helping others, and cooperation. According to the results, competence support certainty fortified the effects of TPSR on students' responsibility development and suggestions were offered to make greater contributions to the theory and the practice applications of TPSR.

THE EFFECT OF A STRENGTH TRAINING PROGRAM IN PHYSICAL EDUCATION CLASSES

PINTO, L., FIGUEIRA, A., ESPADA, M., PEREIRA, A., SOARES, J.

DEPARTMENT OF SCIENCE AND TECHNOLOGY, SCHOOL OF EDUCATION, POLYTECHNIC INSTITUTE OF SETUBAL, PORTUGAL

Introduction

The development of motor skills is an integral part of the National Programs of Physical Education (PE). The school, and in particular the PE classes, should play an important role in optimizing motor skills. Currently, teenagers spend most of their time in front of a monitor (e.g. television, computer or cell phone). The strength in the context of PE classes has many limitations (Santos et al., 2012), training must be settled based on functional exercises, without external weight and using limited material. Therefore, the aim of this study was to verify the effect of a specific training program to develop strength performance.

Methods

The study compared two classes, in which one was subjected to a specific exercise training for the development of strength and the other was restricted only to 'regular' PE session. 40 students engaged in the tenth grade were analyzed , divided into 2 groups (CG, control group and EG, experimental group) where only one was involved in a specific strength training program performed for 40 minutes, 2 sessions per week, during 10 consecutive weeks. The collection of data on functional strength variables (superior, middle and inferior) occurred during the PE lessons, and the tests were adapted from the Fitnessgram test battery (Chen et al., 2016). The data was collected in two phases with a distance of 10 weeks. The subjects were divided into two groups aged between 14 and 15 years of age. For data analysis, descriptive statistics was used, Kolmogorov-Smirnov test to check the normality, the Mann-Whitney test to compare two independent samples and Wilcoxon test to compare both classes at the same time. Statistical Package for Social Sciences 20.0 was used and the significance level considered at P≤0.05.

Results

Both groups significantly increased the results obtained in the evaluations (in the push-ups, sit-ups and jump horizontally) between the pre-test (T1) and post-test (T2) (CG: P≤0.001 and EG: P≤0.000). Between the two moments, no statistically significant differences were observed in the groups (push-ups: T1, P=0.180 and T2, P=0.333; sit-ups: T1, P=0.712 and T2, P=0.701 and jump horizontally: T1, P=0.2284 and EG, P=0.504).

Discussion

The analysis and comparison of results has shown that the group that engage in the specific plan of exercise training achieved better results in terms of strength but not enough to be considered statistically significant. These results show that it is possible to improve the strength also during the 'regular' PE sessions, if the annual planning and consequent didactic units are properly planned and structured. Strength training has a positive effect in the body of children and adolescents, which contributes to a better and healthier growth (Lo et al., 2017). These workouts must be properly designed and possess a competent supervision and should also be safe and effective.

PE TEACHERS' VIEWS OF THE GOOD PRACTICE ON PE TEACHING IN HUNGARY

HAMAR, P.1, KARSAI, I.2, PRIHODA, G.3, CSORDÁS-MAKSZIN, Á.1, SOÓS, I.4

1UNIVERSITY OF PHYSICAL EDUCATION, BUDAPEST, 2UNIVERSITY OF PÉCS, HU, 3HUNGARIAN SCHOOL SPORT FEDERATION, 4UNIVERSITY OF SUNDERLAND, UK

Introduction

After the European Parliament resolution in 2007 a considerable progress was observable in the field of physical education. This resolution attracted the attention of the member states to analyse the status of PE in their countries emphasizing the state of health of the pupils. Also enter the compulsory – at least three times per week– PE classes on every grade of the public education (Hardman, 2011). In Hungary, the Law of 2011 CXC about Public Education is drawn squarely, in primary and secondary schools in ascending system five classes per week was ordained compulsory. This arrangement happened just in time, before it would have become too late, because the general health and fitness condition of the young population began rapidly deteriorate and the inactive lifestyle started to be a sort of sign of the times (Hamar et al., 2010). In our research, we have been seeking the answer among PE teachers, whether good practices exist in daily physical education at all. Our investigation was not only focused on the professional meanings of the contents but also on the different understandings the phenomena of "good practice". Whatever it might mean for a PE professional, this focus is capable to bring up the most diverse, various contents from the teachers.

Methods

During a cross-sectional study, randomly chosen teachers (N=559) have answered open ended questions about the good practice. The data was collected in school year of 2013/14. Data processing was conducted by narrative analysis.

Results and Discussion

Regarding good practice, PE teachers are interested in the issues of infrastructure (the places where to teach, the level of equipment and tool park), sport events for the entire school, the level of preparedness of the teachers and the possibilities to raise this level. It is not surprising at all, not even from the point of view of the teaching methods and also not from the point of view of teaching theory. To be part of the improvements on National Curriculum and to eliminate the false idea of the "overloaded pupils due to daily PE classes" are the most important tasks of the sport professionals.

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Contact
hamar.pal@tf.hu

A COMPARATIVE STUDY OF THE EFFECTS OF TWO TYPES OF CORE STRENGTH TRAINING ON THE AGILITY OF 10-12 YEAR-OLD SOCCER PLAYERS

HOU, H., SUN, L.
MINZU UNIVERSITY OF CHINA; BEIJING ZENGGUANG HIGH-TECH CO., LTD.

Introduction
Agility is an important part of soccer players' physical quality, the training and improvement of which is especially critical for 10-12 year-old soccer players. In addition, core strength of soccer players is essential for their capability to quickly change the trajectory of body movement and maintain body balance. This study looks into and evaluates the effects of two types of core strength training methods on the agility of 10-12 year-old soccer players, providing insights on the design of new training approaches to improve the agility of youth soccer players.
Methods
Twenty soccer players of an age between 10 and 12 were selected and divided into two groups. Both groups undertook agility tests before and after a 10-week training session, including shuffle run, changing-direction run, rope ladder and Nebraska tests. Grouping was based on pre-training test results. During the 10 weeks of training, athletes of one group utilized planks for core strength training while the other group utilized Swiss balls. Pre- and post-training agility test results were analyzed using statistical methods including variance and covariance analyses.
Results
Although both plank and Swiss ball exercises were found to have positive effects, the study showed that Swiss ball training is relatively more effective in improving the agility of soccer players between ages 10 and 12.
Discussion
The muscular strength of rectus abdominis, abdominal oblique muscle, abdominal transverse muscle and latissimus dorsi is essential for soccer players' capability to quickly change and adjust the trajectory of body movement and maintain body balance. In comparison with planks under steady states, Swiss ball, which is unstable, could not only improve athletes' muscle strength and activation level but also stimulate nervous system. As a result, Swiss ball exercises could achieve better training effects in improving agility, which requires both muscle strength and control of nervous system.

A STUDY OF THE EFFECT OF TEACHING GAME FOR UNDERSTANDING UNDER THE COOPERATIVE LEARNING ON BADMINTON SKILLS AND LEARNING ATTITUDE

YATZU, K.1, CHIAMIN, W.1, WEIYUH, L.2, HUNGSHIH, C.1
1: NTSU (TAOYUAN, TAIWAN), 2: FEU (TAINAN, TAIWAN)

Introduction
The teaching game for understanding is the method that is widely popularized and researched in PE education; however, the method doesn't have significant study effect on students' mutual learning. Therefore, the cooperative might be an effective method and it can prompt students to have more effective learning effect under the teaching game for understanding condition. The purpose of this study was to investigate the effect of teaching game for understanding under the cooperative learning on badminton skills and learning attitude.
Method
Data was obtained from ninth grade students (N=59) including two classes over eight weeks. The two classed were randomly assigned to one experimental condition. One group (N=27) worked on the teaching game for understanding. The second group (N=32) worked on the teaching game for understanding under the cooperative learning. In order to examine the leaning effect between two groups, a t-test analysis was performed. Then, a two-way ANOVA was performed to examine different levels of skills and leaning effect.
Results
The result showed that the two groups do not differ with respect to the learning effect. Besides, no statically significant effect of the interaction between low and high groups was found. Furthermore, the two methods both have positive effect on learning attitude.
1、The two groups do not differ with respect to the learning effect.
2、No statistically significant effect of the interaction between low and high groups was found.
3、The two methods both have positive effect on learning attitude.
Discussion
The study can be a reference for adopting the teaching game for understanding. Besides, it also may be beneficial for PE teachers and scholars to study the method in the future. However, the study recommends researchers adopt the participants of different ages or different events. Moreover, researchers can also combine different teaching methods and utilize longitudinal or qualitative study.

A STUDY ON THE EFFECTIVENESS COACHING WITH "MAGNETIC DOLL" IN PHYSICAL EDUCATION

MURAYAMA, D.
SHIGAKKAN UNIV.

Introduction
It is important to conduct a study that examine how students understand movement effectively. It is critical to build the correct "movement conception" for the acquisition of technique (Grosser & Neumaier, 1982). Murayama(2015) have been already developed image devices

that build a movement image effectively. It is a doll that can be displayed on a whiteboard. The doll is made of magnets. He clarified the coaching effect using the magnet doll by instruction of the vaulting box. However, he doesn't examine it about other sports. In such a situation, we examine effective of coach using the magnet doll about other sports. The purpose of the present study was to examine the effectiveness of this specific coaching device to master the movement skills.
Methods
The methods were: 1) to introduce a way to coach using a magnet doll. 2) to extract one learner, regarded as a typical sample, and the process of forming motor imagery, which accompanies the learning process, was analyzed using the tool.
Resulta and Discussion
The single learner sampled from the group was able to achieve a movement to aim for because she was instructed with a magnet doll. The following two points can be concluded from the above example. The first is the possibility of physically making visible the process of forming motor imagery, using the tool. The second is the possibility of using the tool to guide motor imagery formation more accurately than before.

A STUDY OF AMOUNT WATER INTAKE OF SPECTATORS AT SUMMER HIGH SCHOOL BASEBALL GAME IN JAPAN

IIDA, T., SEKI, K., TAKAGI, Y., NISHIMURA, K., MIYASAKA, Y.
SHUJITSU UNIVERSITY

Introduction
Spectators of sport games as well as athletes are at the risk of heat stroke. But, a field survey on thermophysiological response of the spectators, which are risk factors for heat stroke, has not been reported. The National High School Baseball Championship in the summer is one of the most popular sport games in the education at schools. Heat stroke in the spectators of high school baseball has recently been recognized. We clarified that the spectators at the baseball game in summer lacked water intake depending on their thirst rating. Therefore, the purpose of this study is to clarify the influences of different water intake amount of the spectators in the summer high school baseball on weight loss amount.
Methods
We conducted 3 times field surveys at high school baseball games held in summer. 10 healthy male(21±1yrs、169.9±4.0cm、63.4±7.1kg) at the survey I, 14 healthy male(19±1yrs,170.4±5.7cm,62.8±9.5kg) at the survey Ⅱ, and 19 healthy men(23±4yrs,173.3±7.2cm,66.6±10.1kg) at the survey Ⅲ volunteered for study. The subjects drunk the mineral water during watching high school baseball games in an outside baseball field. The drink conditions were that a free drink group at survey Ⅰ, free drink group VS regulated drink group (100 ml in even number inning: total 400 ml) at survey Ⅱ, free drink group VS regulated drink group (200 ml in odd number inning: total 1000 ml) at survey Ⅲ. Water intake, weight loss and sweat loss in the subjects were measured.
Results and Discussion
In the free drink group of survey I (WBGT:34.6±0.7°C), the subjects drank 370.5 ± 132.4 ml of mineral water and to sweat 915.5 ± 271.9 ml. The amount of perspiration showed a higher value than the water intake. In survey II (WBGT:31.4±1.6°C), the subjects of free drink group drank 704.0±174.9 ml and to sweat 1011.0±368.3ml. The regulated drink group drank 400 ml and to sweat 771.4±111.3 ml. The amount of perspiration showed higher than the intake of water in both groups. In survey Ⅲ (WBGT:30.0±1.8°C), the subjects of free drink group drank 297.3±208.0 ml and to sweat 697.3±118.7ml. The regulated drink group drank 1,000 ml and to sweat 883.3±132.9 ml. In the regulated drink group, the water intake amount was higher than the amount of perspiration. These results indicates that spectators in heat enviroment sweat about 1000 ml even if they sitting and resting about two hours. It clalify that the spectators at the baseball game in summer lacked water intake depending on their thirst rating.

A RELATIONSHIP BETWEEN A PLAYGROUND EQUIPMENT OF THE PARK AND MOTOR ABILITY OF CHILD

YAMADA, M.
TOKAI GAKUIN UNIVERSITY

Introduction
It is important to conduct a study that examine the movement ability of children. In japan, there are a lot of parks that a child can play exercise. A lot of environmental research about the playground equipment of the park had studied until now. Most of these studies were on the area of the park, the setting situation of playground equipment, the exercise time of the child and the relationship with others. Those studies said that it is important to fix the environment to secure more exercise time. However, there are not many studies on the relationship with a playground equipment of the park and motor ability of child. The purpose of this study was to clarify the playground equipment of the park and the relationship with a playground equipment of the park and motor ability of child.
Methods
The method was as follows;
-to investigate the playground equipment in some parks, and showing a characteristic.
-to investigate the characteristic of the playground equipment which the child of the playground equipment used with curiosity positively.
-to show a condition for motor ability improvement of the children.
Results
It was liked to children that the playground equipment with the height, the playground equipment of the achievement type, and the compound playground equipment that mixed various device type.
Discussion
The following three points can be concluded from the result. It is important that; 1) the playground equipment which gives curiosity to children, 2) the playground equipment which gives a child sense of accomplishment, 3) the playground equipment which conflicts between challenge and resignation.

PERSONAL AND SOCIAL RESPONSIBILITY SCALE IN COLLEGE P.E. SETTINGS: DEVELOPMENT AND CONSTRUCTION

LEE, I.S., CHOU, H.S., PAN, Y.H., KUO, T.L.
NATIONAL TAIWAN SPORT UNIVERSITY

Introduction

The present study is based on the Teaching Personal and Social Responsibility (TPSR) model of Hellison (2011) and organized around the factors of respect, effort, cooperation, self-direction, helping others, and leadership. Through both qualitative and quantitative methods, a scale has been developed as a means to measure individuals' personal and social responsibility in college PE settings.
Methods
The methodology adopted was a three-phase qualitative and quantitative procedure whereby the scale was designed. In the first phase, a scale was constructed and developed qualitatively to measure personal and social responsibility of college students. In the second phase, exploratory factor analysis (EFA) was carried out to further construct the scale. In the third phase, confirmatory factor analysis (CFA) was employed to examine the fit between the hypothesized model and empirical observation. The participants consisted of 1031 individuals.
Results
The results show that the proposed scale is a both valid and reliable means to assess personal and social responsibility in college PE settings in terms of the six values of respect, effort, cooperation, self-direction, helping others, and leadership.
Discussion
The (CSRQ) of Watson, Newton, and Kim (2003) puts forward the three factors. It is not immediately clear why caring for others and goal-setting are conflated into a single factor. Li, Wright, Rukavina, and Pickering (2008): The two phases that include two factors are: effort and cooperation, helping and leadership. However, the use of two factors are likely to lead to confusion in practical application. The (SRIPES) of Hsu, Pan, Chou, Lee, and Jing (2013) encompasses six factors, but regrettably omits leadership. The value of the present study lies in its complete coverage of the six factors of respect, effort, cooperation, self-direction, helping others, and leadership.
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ESTONIAN NATIONAL DEFENCE COLLEGE GRADUATES READINESS TO CONDUCT PHYSICAL TRAINING FOR CONSCRIPTS.

STAMM, M., ANTSON, H.
ESTONIAN DEFENCE FORCES HEADQUARTER

Introduction
Conscription puts young men in hard physical and mental environment. Their level of physical ability is very different at the beginning of service. It is necessary to take individual approach to avoid traumas caused by over fatigue. At the same time it is necessary to develop the skills needed for future service. That places huge responsibility on the personnel responsible for planning and conducting physical training in units (Schempp et al., 2010; Walsh, 2011). Every year new officers and NCOs who will be responsible for conscripts' physical development graduate from the Estonian National Defense College (ENDC).
Methods
A poll was conducted to answer the research question about the personal opinion of graduates for their readiness to conduct physical training for conscripts based on the knowledge gained during their studies in the ENDC. The questionnaire consisted different questions about knowledge in physical education, sport physiology, sports psychology, sport medicine, sport pedagogy also for using/asking help for unit sport instructor about PE. Sample consisted of 70 officers and NCOs who graduated ENDC three years ago and served in different units between 2013 -2016.
Results
It was found that a huge number of graduates who plan and conduct physical training for conscripts do not have enough (very good, good, satisfactory) knowledge to do that properly according to all standards of physical training (52% in sports psychology; 43% sport medicine; 33% in sport pedagogy; 29% in sport physiology; 10% in PE). Besides, the used methods only partially meet the needs to develop young men properly. Also was found that the graduates do not have enough practical skills to conduct proper physical preparation of personnel. All lessons about physical preparation in the ENDC take place during the first study year, and the obtained knowledge is not used in practice for the rest of the studies in the college.
Discussion
Obtaining a successful instructor requires extensive knowledge and skills as well as hands-on experience (Gilbert et al., 2010; Schempp et al., 2010). It is necessary to develop a new system in the ENDC that prepares graduates better for their future tasks in conducting physical preparation of conscripts. The program should be spread over three years and it should include practical planning and conducting physical training.
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WHAT RESEARCH TELLS US ABOUT PE-CPD IN KOREA: A REVIEW OF LITERATURE

LEE, O., CHOI, E., JUNG, H., YOON, K.
SEOUL NATIONAL UNIVERSITY

Introduction
There is a growing research interest in teachers' continuing professional development (CPD) given that CPD is one of the critical components of enhancing quality of education. The purpose of this paper is to explore the trend and issues of CPD research conducted in physical education (PE) context in South Korea.
Methods

A total of 70 studies on PE-CPD were selected based on the following two selection criteria: (1) studies including at least one of the following key words: 'in-service teacher training', 'staff development', 'teacher professional learning', 'PE teacher learning community', 'PE teachers' professional growth', and 'professional development.' (2) studies published since the year 2000. The selected studies were analyzed in terms of: research topic, research methods, duration of the study, and major outcomes and implications.
Results
First, the majority of studies have explored effectiveness of PE-CPD conceptually rather than data-based empirical research. Second, the duration of CPD programs did not reflect the nature of 'continuous' or 'continuing' professional development with the short-term duration of implementation. With this limitation, most of the PE-CPD studies could not explore the process or mechanism of teacher growth through the participation of PE-CPD programs. Third, the impact of PE-CPD was explored mainly in terms of changes in teachers' knowledge and skills rather than changes in students' learning outcomes. Fourth, although diverse types of PE-CPD including university-based learning community, the school-based learning community, formal teacher training program, and other informal activities were explored, yet little information exist which types of CPD are more effective than others.
Discussion
The issues and trends found in this review are quite similar to studies conducted in other countries. There should be more empirical studies on PE-CPD with long-term implementation. Given that enhancing students' learning outcomes is the ultimate goal of PE-CPD, future studies should pay more attention to the impact of PE-CPD on student learning outcomes.

WHAT ARE THE FACTORS THAT AFFECT STUDENTS' MOTIVATION FOR PHYSICAL EDUCATION?

SHIMIZU, Y.1, YAMAUCHI, H.1, MIYAZAKI, M.2

1: INTERNATIONAL CHRISTIAN UNIVERSITY, 2: J.F. OBERLIN UNIVERSITY

Introduction
A sedentary lifestyle, a chief contributing factor for lifestyle-related diseases, is widespread in Japan, even among the young population (Ministry of Health, Labor and Welfare, 2014). One of the reasons why some people are reluctant to exercise is that they hated physical education class and/or PE teachers and then has come to view physical activities in general as a source of unnecessary suffering. The aims of this study were to develop Teaching Evaluation Scale for Physical Education Courses (TESBAC) and Psychological Adaptation Scale for Exercise Courses (PASEC) and to examine the relationship among the factors of TESBAC and PASEC.
Methods
The subjects of 515 university students enrolled in a PE course (149 males and 366 females, mean age=20.49, SD=1.21) were asked to answer a questionnaire on teaching evaluation and psychological adaptation in February 2017. Exploratory factor analyses and reliability analyses were conducted to develop Teaching Evaluation Scale for Physical Education Courses (TESBAC) and Psychological Adaptation Scale for Exercise Courses (PASEC). In order to examine the relationships between TESBAC and PASEC, step-wise multiple regression analyses were conducted.
Results
The results of exploratory factor analyses identified that TESPEC has a 8-factor model with 40 items ("Teacher-student Trust," "Sports Safety Knowledge," "Friendly Attitudes," "Student-centered Approach," "Clear-cut Lesson Plans," "Team Building Skills," "Insight into Students' Thinking," and "Clear Evaluation Criteria") and PASEC has a 2-factor model with 10 items ("Adaptation" and "Maladaptation"). Reliability analyses and confirmatory factor analyses confirmed that both TESPEC and PASEC had satisfactory Cronbach's alpha coefficient reliabilities and structural validities. Multiple regression analyses showed that "Teacher-student Trust," "Friendly Attitudes," "Student-centered Approach," "Team Building Skills" and "Insight into Students' Thinking" were positively associated with "Adaptation," and "Friendly Attitudes" and "Clear Evaluation Criteria" were negatively associated with "Maladaptation."
Discussion
The results above indicate that, in a university physical education class, perceived instructors' communication skills and student-oriented atmosphere are likely to have more impact on students' positive evaluation than knowledge and lesson plans. This implies that interpersonal relationships between teachers and students need to be given more focus in order to increase students' motivation for physical education classes and, in the long run, for physical activities in general.
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Contact
syasuo@icu.ac.jp

FACTORS ASSOCIATED WITH SAFETY KNOWLEDGE ON ALPINE SKI SLOPES

GERHARD, R., POCECCO, E., BRUNNER, F., GREIER, K., HILDEBRANDT, C., RASCHNER, C.

UNIVERSITY OF INNSBRUCK

Introduction
The jurisdiction after a winter sport accident including a third party fault considers the 10 rules for safe skiing/snowboarding introduced by the International Ski federation (FIS) to clarify the question of liability. A previous study (Hildebrandt et al. 2011) revealed that beginners, young skiers and those who were not local residents displayed insufficient safety knowledge in given situations. The aim of this study was to evaluate additional factors associated with safety knowledge on ski slopes, e.g. type of performed winter sport, helmet use, risk taking behavior, and a previous injury occurred on a ski slope.
Methods
People participating in recreational snow sports were interviewed in March 2012 at 2 weekends in 5 Austrian ski areas using a standardized questionnaire. Participants had to correctly answer a total of 12 statements (yes vs. no vs. no answer) according to safety knowledge based on the 10 FIS rules comparable to the study by Hildebrandt et al. (2011).
Results
A total of 602 persons (67% skiers) with a mean age of 32.8±14.6 (Range: 8-77) years were interviewed. In total, 12 and 11 statements were correctly answered by 14% and 25%, respectively. A total of 19-38% of participants did not correctly answer those statements including an appropriate behavior on the ski slope (overtaking, priority, stopping, and adapting speed). Safety knowledge in this study was significantly lower among snowboarders, females, the youngest age group, beginners, persons with the lowest frequency of winter sport participation, and persons without a previous injury, respectively.
Discussion

Compared to skiing snowboarding is associated with a lower mean age and younger age is also often associated with a lower skill level and with a lower frequency of winter sport participation. Thus, preventive programs to enhance safety knowledge and safe behavior on ski slopes should especially focus on snowboarders, younger age groups and beginners.
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Contact
Gerhard.ruedl@uibk.ac.at

A SELF-STUDY: ROLE CONFLICT EXPERIENCE PROCESS OF PHYSICAL EDUCATION TEACHER EDUCATOR & TABLE TENNIS COACH

KIM, W.
KONGJU NATIONAL UNIVERSITY

The purpose of this self-study is to address the role conflict experience of physical education teacher educator and coach. This paper has been analyzed and written in the narrative approach of role and responsibility as a teacher educator in the college of education and a coach, considering educational reality and context. Especially, I implemented self-study and described this process in a personal historical narrative text by using 'memory work' through the critical and reflective remembrance. This study premised on understanding of the university system and institutional context. And I retold my public status, roles, and role conflict within the educational context, considering role and life of a teacher educator in the college of education and a coach. This research has found the largely two dilemmas caused by role conflicts. (1) the differentiation in mind and body, (2) the overlap of time and space according to the role overlap and decision making dilemmas. Ultimately, this role conflict experience could make it possible to search desirable directions and solutions through self-reflection of the identity and subjectivity as a educator.

PREPARING VIRTUOUS PHYSICAL EDUCATION TEACHERS IN KOREA: PRACTICES AND PROBLEMS IN TEACHER EDUCATION PROGRAMS

PARK, M., CHOI, E., RYU, G.
SEOUL NATIONAL UNIVERSITY

Introduction
Educating students to be more virtuous has been a main policy agenda for the last several years in Korea. Even National Curriculum(NC) has been revised to emphasize students' character and educate them to be more virtuous. Every school subject has to prove itself effective to student character development. Numerous continuing professional development(CPD) programs have been provided to physical education(PE) and other subject teachers. The evaluative comments on this approach has, in general, not been very positive. It is said that the preparation should start in PE teacher education(PETE) phase, not in on-the-job stage.
This study purpose to identify how well PETE institutions are doing in preparing good PE teachers. Two research questions were asked. First, how does the character education(CE) for preservice PE teachers(PPET) being done? Second, what are the problems of those practices? Five comprehensive universities which have PE department are selected and their PE preparation curricular are analyzed.
Methods
One or two TE faculty in each university who are responsible for the preparation program are interviewed for the characteristics and strengths of their programs. PPETs were also interviewed for their perspectives on and effectiveness of their programs.
Results
The results were as follows: First, TE faculty, curricular and students were not well prepared to provide CE for PPETs in university. Contrary to the demands of NC, not all universities explicitly emphasize CE for their PPETs in curricular programs. It was indirectly and sporadically emphasized in course teaching and informal discussions. Although TE faculty expressed and some contents covered, overall, CE was not an important curricular issue for every professors and the department. It was not taught in systematic ways. It was not possible, at least not effective, for PPETs have a clear understanding, skills and eagerness on CE.
Second, it seemed that the substantial incorporation of CE in PETE would not occur in any easy way. The stereotypical thoughts of professors, and even students, for example, that people's character do not change, thus it is not easy to change was one of huge barriers. The education related courses and physical activity classes also did not specifically focus on how to teach PPETs' character. Mainly theories and skills are emphasized. Other barriers such as curriculum committees and lectures were other reasons why the CE for PPET did not effectively occur.
Discussion
We conclude with some suggestions for the PETE programs could be more CE friendly or effective.

Physiology

HEALTH AND ATHLETIC PERFORMANCE DURING RAPID WEIGHT REDUCTION IN COMBAT SPORTS

YANG, W.H., HEINE, O., MESTER, J., GRAU, M.
GERMAN SPORT UNIVERSITY COLOGNE, OLYMPIC TRAINING CENTRE RHINELAND

Introduction
This study aimed to summarize profound aspects and present original research data of rapid weight reduction (RWR) in combat sports such as taekwondo, judo, boxing and wrestling. In previous studies, RWR may cause potential health risk and decreases athletic performance.
Methods
Project-related results were presented and a comprehensive literature search was performed to identify articles on the specific contexts of RWR in this review. Extensive literature research was conducted using PubMed and Google Scholar with relevant keywords applied.
Results
RWR Methods used by the athletes include food restriction, dehydration and intensive exercise. After RWR increased oxidative stress, an imbalance of electrolytes and hormones, decreased glycogen or changes in blood flow (Yang et al., 2014) as well as decreased plasma volume have been reported. Hemorheological properties such as deformability and aggregation of red blood cells are impaired after RWR which may in part related to impaired nitric oxide generation and which overall may negatively influence microcirculation (Yang et

al., 2015). Another knowledge in blood flow indicates a peak value of plasminogen activator inhibitor-1 (PAI-1) in the morning of the human circadian system which also damages cardiovascular events and endanger their health. Furthermore, RWR-induced hypohydration leads to reduced psychological performances.
Discussion
RWR related impairments may decrease oxygen consumption, aerobic and anaerobic capacity, muscle strength, psychological concentration and targeted sport-specific performance of combat athletes. Therefore, a long-term plan of weight reduction should be created individually. If RWR is preferred as weight loss method, athletes and coaches should avoid a high intensity training in the morning during the period of RWR due to impaired physiological responses.
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Contact
ywh1235@hotmail.de

THE PLASMA FREE FATTY ACID SUPPLY AFFECTS THE RATE OF CERAMIDE SYNTHESIS IN DIFFERENT SKELETAL MUSCLE TYPES.

GÓRSKI, J., ZABIELSKI, P., BŁACHNIO-ZABIELSKA, A., CHABOWSKI, A.
MEDICAL UNIVERSITY

Introduction
Ceramide is the key compound in sphingolipid metabolism, which possesses strong biological activity. The main source of ceramide is de novo synthesis. However, the rate of ceramide synthesis was evaluated, so far, only indirectly. The aim of the present study was to measure the rate of ceramide synthesis in skeletal muscles directly, using labeled [U-13C]palmitic acid.
Methods
The experiments were carried out on male Wistar rats, approx. 350g of body weight. The animals were divided into three groups: 1-control, 2-with reduced plasma free fatty acid concentration by means of nicotinic acid and 3-with elevated plasma FFA concentration by means of intralipid + heparine. The animals were anaesthetized and each compound was infused for two hours along with [U-13C]palmitate (1, 2, 3). Control group received phosphate buffered saline and label infusion. Blood was taken every 30min. At the end of infusion samples of the soleus (slow-twitch oxidative muscle) and white section of the gastrocnemius (fast twitch glycolytic muscle) were taken. Plasma FFA concentration and composition was measured by means of gas-liquid chromatography. Plasma palmitate enrichment was measured according to (4), with the use of Agilent 1290 UHPLC and Agilent 6460 triple quadrupole mass spectrometer. Muscle sphingosine, sphinganine and ceramide content and isotopic enrichment of palmitoyl-ceramide was measured according to [4] with the use of LC/MS/MS.
Results
In the control group, the ceramide fractional synthesis rate (Cer FSR) in the white gastrocnemius was significantly lower than in the soleus. In I+H group, Cer FSR in each muscle was significantly higher as compared to the respective control value. Reduction in the plasma FFA level (NA group) did not effect Cer FSR in the soleus muscle and decreased it in the white gastrocnemius. Elevation in the plasma FFA (I+H group) led to modest, yet significant increase in ceramide content whereas reduction in the plasma FFA level (NA group) reduced the content of the compound in the muscles.
Discussion
Cer FSR depends on plasma FFA supply and the muscle type. The differences in the content of ceramide between the muscles cannot be solely explained by differences in Cer FSR. They are possibly also affected by the rate of ceramide degradation and complex sphingolipid synthesis.
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Contact:
gorski@umb.edu.pl

EFFECTS OF CYCLING CADENCE AND EXERCISE DURATION ON NON-LINEAR DYNAMICS OF HEART RATE VARIABILITY AND CORTICAL ACTIVITY

GRONWALD, T., HOOS, O., LUDYGA, S., HOTTENROTT, K.
UNIVERSITY OF HEALTH & SPORT

Introduction
Measures of brain cortical activity in relation to exercise-induced changes in autonomic control may provide means of a holistic approach to gain new insights into the complex control mechanisms of fatiguing exercise. Therefore, the purpose of the current study was to investigate the influence of exercise duration and cycling cadence on total variability and complexity of heart rate variability (HRV) in conjunction with cortical activity measured with electroencephalography (EEG).
Methods
Sixteen trained cyclists (age: 25.9±3.8y; height: 180.7±6.1cm; body mass: 77.4±8.2kg; body fat: 12.3±3.4%; VO2peak: 54.1±6.1ml/min/kg) completed a 60min exercise session at 90% of the individual anaerobic threshold on a bicycle ergometer. Cadence was changed every 10 minutes (90-120-60-120-60-90rpm), while the workload was held constant. RR-intervals and EEG (alpha: 7.5-12.5Hz, beta: 12.5-32.0Hz, total spectrum: 7.5-32.0Hz) were recorded continuously during exercise. Regarding HRV parameters, time domain measures and fractal correlation properties were analyzed using the short-term scaling exponent alpha1 of detrended fluctuation analysis (DFA). Moreover heart rate (HR), blood lactate concentration (La) and rating of perceived exertion (RPE) were recorded at regular intervals.
Results
In comparison to 60 and 90rpm, participants' HR, La and RPE were increased during cycling at 120rpm ($p \leq 0.05$). Similarly, EEG spectral power in the beta band and total spectrum was increased at the highest cadence ($p \leq 0.05$). In contrast, all analyzed HRV parameters

showed decreased values from lower cadences to 120rpm ($p \leq 0.05$). Whereas HR and RPE increased over time ($p \leq 0.05$), all analyzed HRV and EEG parameters decreased from the first to the last interval with the same cadence at 90 rpm ($p \leq 0.05$).
Discussion
The results show that exercise duration and cadence have an impact on metabolic, cardiac and nervous system parameters. In this respect, HRV values decreased over time and in response to higher cadences. This change may be due to increased organismic stress and indicates a decrease in the overall variability as well as complexity of the RR-interval-fluctuations. The decrease of DFA-alpha1 could also be associated with an organismic system withdrawal to ensure homeostatic protection. Recalling that this change was accompanied by a decrease of EEG spectral power, our findings provide new insights for the discussion of complex fatigue models and allow a more sophisticated analysis of the overall organismic demands.
Contact
thomas.gronwald@my-campus-berlin.com

INTERMITTENT HYPOXIC TRAINING MODULATES INFLAMMATORY MARKERS IN GRECO-ROMAN WRESTLERS

POKRYWKA, A., MORAWIN, B., BAUMGARTEN, M., GRZESIAK, J., ZEMBRON-LACNY, A.
UNIVERSITY OF ZIELONA GORA, FACULTY OF MEDICINE AND HEALTH SCIENCES

Introduction
Intermittent hypoxic training (IHT) is one of the methods used in professional sports to improve physical performance (Millet et al., 2010). Systemic exposure to hypoxia increases the production of reactive oxygen and nitrogen species (RONS) as well as erythropoietin (EPO), which stimulates the adaptation to physical exercise (Vogt and Hoppeler, 2010). On the other hand, acute hypoxia may increase tissue damage and inflammation associated with overtraining in athletes (Clanton, 2007). The aim of the study was to investigate the effect of wrestling training in combination with IHT on changes in inflammatory response in wrestlers.
Methods
Blood samples were collected from Greco-Roman wrestlers (IHT n=6; control n=7) during 5-day IHT cycle using hypoxicator GO2Altitude. In serum, hydrogen peroxide (H_2O_2), nitric oxide (NO), 3-nitrotyrosine (3-NT), pro-inflammatory cytokines (IL-1β and TNFα) and C-reactive protein (hsCRP) were determined.
Results
IHT significantly increased H_2O_2 and NO but decreased 3-NT concentrations. This means higher NO bioavailability following hypoxia. IL-1β, TNFα and hsCRP concentrations significantly increased after IHT. There were no changes in hematological markers (Ret, RBC, Hb and Htc).
Discussion
IHT with wrestling training induces immunological response but not hematological one. The high inflammation can increase a risk of overtraining in athletes, however, considerable further research is needed into this subject.
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MEASUREMENTS OF SPONTANEOUS PHYSICAL ACTIVITY USING INDIVIDUAL IDENTIFICATION TECHNOLOGY IN EXERCISING RATS

YANAGITA, S., KUBOTA, N., KANEMASA, Y., YAMAMOTO, T., TAKEDA, K.
TOKYO UNIVERSITY OF SCIENCE

Introduction
Spontaneous wheel running (SWR) is a common experimental model to investigate the beneficial effects of physical activity in animal study. Numerous studies have shown that SWR is associated with health benefits especially for brain and behavior. Furthermore, the amount of SWR influences the beneficial outcomes after physical exercise. On the other hands, recent studies noted that the housing conditions, such as single housing or group housing, change the beneficial outcomes of SWR. SWR in the single housing condition may blunt the beneficial effects of physical exercise compared to that in the group housing conditions because group and social housing is usual condition for experimental rodents. Therefore, it is necessary to evaluate the effects of SWR in group hosing conditions. However, it is difficult to calculate individual physical activity in group hosing condition correctly. Almost studies investigated the effects of SWR in the group housing conditions could not detect individual physical activity in each rat, or calculated only running distances in each cage (sum of all rats in the same cage). Although there are a few studies analyzing the individual SWR distance in group housing using visual observation or motion picture analysis, these analyses have less objectivity and are necessary to do hard work to analysis the data correctly. In the present study, we analyzed the amount of SWR distance and physical activity in the cage in group housed rats using our original individual identification and tracking systems.
Methods
We employed microchip and radio frequency identification (RFID) technology in order to calculate running distance and locomotor activity in each rat. The rats were implanted with subcutaneous microchips, i.e., electronic identification devices, providing each rat with a unique identification number. After surgery, the rats were randomly assigned to either single or group and social hosing conditions. The rats in both conditions were allowed free- accessible wheel running 4 weeks. All cages were equipped to monitor an individual access to running wheel of each rat. Our system can realize communicating the reader coils and the RF tag that is injected into rat, and both tracking and individually identifying of rats by scanning reader antenna coils embedded in the floor surface.
Results and Discussions
In the results of present study, we could detect individual variability on SWR distances of each rat in group housing conditions as well as single housed rats. The result of present study suggests that our original individual identification and tracking systems is useful for analyzing physical exercise behaviors in group and social housing conditions in rodents.

THE INFULENCE OF 6 WEEKS RESISTANCE TRAINING ON GUT FUSOBACTERIUM AND INFLAMMATORY MARKERS IN INACTIVE YOUNG ADULTS

WU, C.1, SHIH, J.2, CHEN, C.1, CHIU, H.3, CHANG, C.3

1: NATIONAL CHUNG HSING UNIVERSITY (TAICHUNG, TAIWAN), 2: SHOW CHWAN MEMORIAL HOSPITAL (CHANGHUA, TAIWAN), 3: NATIONAL TAIWAN UNIVERSITY OF SPORT (TAICHUNG, TAIWAN)

Introduction
The link between exercise and microbiome changes has never been considered in the mechanism of exercise reduced colorectal cancer (CRC) risks. Recent findings showed the strong link between Fusobacterium and CRC. We hypothesize exercise may influence anaerobe, Fusobacterium, and immune function to reduce CRC risks.
Methods
Twenty-three young, healthy, inactive subjects participated in either resistance exercise group (RE)(12) or control group (CON)(11). RE was instructed to perform resistance exercise at 50% of 1RM, 2 sets, 3 times/week for 6 weeks after 4 weeks original inactive life style. CON was remained their inactive life style for 10 weeks. Samples collection time was at week 0, week 4, and week 10. Blood samples were analyzed for cytokines (TNF-α, IL-1β, IL-6, and CRP), leucocyte counts (lymphocyte, neutrophil) and biochemistry markers (glucose, triglyceride, cholesterol, HDL-C). Saliva and stool samples were used to investigate the Fusobacterium using the qPCR technique.
Results
Results showed that there were no significant differences in plasma cytokines (TNF-α, IL-1β, IL-6, and CRP), biochemistry markers (glucose, triglyceride, cholesterol) and leucocyte counts (lymphocyte, neutrophil). HDL-C concentration was increase in RE after training. The stool Fusobacterium concentrations showed a trend of decrease in RE after 6 weeks training.
Discussion
The present study showed the gut Fusobacterium was reduced after 6 weeks resistance exercise training. The outcome indicated that the resistance exercise might be partially reduced the risk of CRC. However, there were no significant changes in inflammatory markers in the health inactive young subjects after training. The further study to investigate the impact of exercise on CRC patients and the variety of gut microbiome is warrant.
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Contact
psclw@dragon.nchu.edu.tw

THE EFFECT OF PROFESSIONAL SPORT TRAINING ON CIRCULATING APOPTOTIC MARKERS OF VASCULAR INFLAMMATION

BAUMGARTEN, M.1, MORAWIN, B.2, TYLUTKA, A.2, POKRYWKA, A.2, ZEMBROŃ-ŁACNY, A.2

UNIVERSITY OF ZIELONA GORA

Introduction
Apoptosis of immune and endothelial cells is observed during aseptic vascular inflammation. It can be caused by high level of various pro-apoptotic factors such as tumour necrosis factor (TNFα), nitric oxide (NO) and 3-nitrotyrosine (3-Nitro), free and oxidised low-density lipoproteins (oxLDL) generated during long-term intense exercise. Endothelial dysfunction resulting from elevated inflammatory and pro-apoptotic mediators has been implicated in cardiovascular diseases (CVD) [Agrotou et al. 2013, Föstermann 2010, Zhang et al. 2009]. We examined the effects of sport training on pro-apoptotic factors and their interaction with aseptic vascular inflammation.
Methods
Blood samples were collected from elite Greco-Roman wrestlers (n=16) during preparatory period for the new season (pre-season, January) as well as from non-athletes (n=12).
Results
NO concentration did not differ between groups while TNFα, 3-Nitro, oxLDL and hsCRP were significantly higher in wrestlers compared to non-athletes. Wrestlers showed the high levels of TNFα, 3-Nitro, hsCRP, total cholesterol (TC), LDL lipoproteins and atherogenic coefficient (AC). 3-Nitro concentration correlated with hsCRP ($r=0.609$, $p<0.001$), LDL ($r=0.381$, $p<0.05$) and AC ($r=0.408$, $p<0.001$).
Conclusion
The findings suggest that sport training may be associated with higher levels of pro-apoptotic mediators are related to other conventional CVD risk factors.
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Contact
m.baumgarten@wlnz.uz.zgora.pl

ASSOCIATIONS BETWEEN CARDIORESPIRATORY RESPONSES, PERCEIVED EXERTION AND AFFECT DURING ISOLATED AND TRIATHLON-SPECIFIC CYCLING TIME-TRIALS

TAYLOR, D.

UNIVERSITY OF LINCOLN

Introduction
Compared to other cardiorespiratory parameters, respiratory frequency (fR) is suggested as one of the most important contributors to self-paced endurance performance. This is based on the strong relationship fR shares with RPE, irrespective of event duration (Nicolò et al., 2016). However, it is yet to be established if fR and RPE interaction differs during multi-modal events (i.e. triathlon). Indeed, the complexity of such exercise may well alter the relationships that are typically seen between perceptual and physiological status during single-

mode events (Taylor & Smith, 2013). Furthermore, it is suggested that affective status may be more important than RPE to the pacing of endurance performance. This study therefore examined the associations between cardiorespiratory responses, RPE and affect during isolated and triathlon-specific cycling performance.
Methods
Eleven non-elite male triathletes (mean ± SD: age 36.9 ± 8.4 yrs, VO2max 4.1 ± 0.3 l/min, Wmax 344 ± 21 W) completed two laboratory-based trials 9 ± 4 days apart, each incorporating a 500 kJ (~20 km) cycling time-trial (CTT) performed on an SRM ergometer. The first CTT was completed in isolation, whilst the second CTT formed part of a simulated sprint-distance triathlon (0.75 km flume swim, 500 kJ bike, 5 km treadmill run). Cardiorespiratory (fR, VE, VO2, VT, HR) and perceptual (RPE and affect) responses were obtained every 100 kJ. Relationships between these measures were examined by calculation of within-subject correlation coefficients.
Results
During isolated CTT's, RPE was significantly related ($p < 0.05$) with fR ($r = 0.80$), VE ($r = 0.58$), VO2 ($r = 0.57$), VT ($r = 0.49$) and HR ($r = 0.79$), whilst affect was significantly related ($p < 0.05$) with fR ($r = 0.70$), VE ($r = 0.37$), VT ($r = 0.63$) and HR ($r = 0.67$) but not VO2 ($r = 0.26$). During triathlon-specific CTT's, RPE was significantly related ($p< 0.05$) with fR ($r = 0.51$), VO2 ($r = 0.30$), VT ($r = 0.43$) and HR ($r = 0.51$) but not VE ($r = 0.03$), whilst affect was significantly related ($p < 0.05$) with fR ($r = 0.47$), VT ($r = 0.60$) and HR ($r = 0.43$) but not VO2 ($r = 0.09$) or VE ($r = 0.08$).
Discussion
In accordance with Nicolò et al. (2016) fR demonstrated the strongest relationship with RPE across both CTT's, relative to other cardiorespiratory measures. This trend was also apparent for the relationships between cardiorespiratory responses and affect, though the strength of these was generally lower compared to those seen with RPE. Associations between perceptual and cardiorespiratory responses were also consistently weaker during triathlon-specific CTT. These findings support the view that fR and RPE interaction may be one of the most important contributors to pacing during single and multi-modal events, whilst also illustrating unique relationships between perceptual and physiological responses during triathlon cycling.
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Contact
dtaylor@lincoln.ac.uk

THE EFFECTS OF SODIUM BICARBONATE INGESTION ON RECOVERY OF WINGATE TEST PERFORMANCE IN THE HEAT.

MUNDEL, T.
MASSEY UNIVERSITY

Introduction
Ingestion of sodium bicarbonate as an ergogenic aid has been researched thoroughly as a buffering mechanism that effectively attenuates blood acidosis and consequently delays fatigue during high-intensity anaerobic exercise. However the effect of sodium bicarbonate on (recovery of) performance in the heat has not been as thoroughly investigated. This study aimed to investigate the effect of sodium bicarbonate ingestion on recovery of Wingate test performance during exercise in the heat.
Methods
At 30 °C (~50% relative humidity), ten male team sport athletes (mean values ± SD; Age = 22 ± 4 y; body mass = 76 ± 9 kg) completed two 30s Wingate tests using a resistive load of 7.5% of body mass separated by 5 min of active recovery. They consumed either sodium bicarbonate (0.5g/kg body weight) or sodium chloride as a taste-matched placebo (0.2g/kg body weight) divided into 3 doses at 4h intervals on the day of each test. Performance measures included peak power, rate of fatigue and anaerobic capacity whilst physiological measures of venous pH, bicarbonate and lactate were taken 3 min following each Wingate test.
Results
At all time-points (baseline and following both Wingate tests) venous pH and bicarbonate were higher with sodium bicarbonate, whilst lactate was higher following both Wingate tests with sodium bicarbonate (all $p < 0.02$). Anaerobic capacity was similar during the first Wingate but was higher with sodium bicarbonate during the second Wingate ($p < 0.05$), however neither peak power nor rate of fatigue were different between the trials during either Wingate (all $p > 0.28$).
Conclusion
When performing high-intensity anaerobic exercise in the heat, sodium bicarbonate ingestion improves recovery and repeated exercise performance but does not alter the pacing strategy adopted likely through its known effects for alkalosis.
Contact
t.mundel@massey.ac.nz

MILD BILATERAL JUGULAR VEIN COMPRESSION ALTERS CEREBRAL HEMODYNAMICS: IMPLICATIONS FOR SPORT CONCUSSION

DECH, R.T., BISHOP, S.A., NEARY, J.P.
UNIVERSITY OF REGINA

Introduction
Sport concussion has become a major issue in contact sport (Abaji et. al 2015; Len et al. 2011). There have been great strides made to improve tracking of injury status, however, much is to be learned in the diagnostic and prevention fields. Recently, there have been efforts made to examine the mechanisms within the body to artificially simulate environments to protect the brain (Myer et al. 2016). We tested the hypothesis that mild bilateral jugular vein compression would alter cerebral hemodynamics during a bent-over head position task used to challenge the subarachnoid hemodynamic processes in the frontal lobe.
Methods
Nine healthy participants (5M, 4F) performed a randomized-block continuous 20-minute protocol (5-minute seated rest, 2-minute bent-over position test (BOPT), and 3-minute seated recovery), repeated with no rest between trials. Participants completed the protocol once without compression (NC) and once with a compression collar (CC). The collar was placed on the subject's neck, applying gentle bilateral pressure over the jugular veins. Near-infrared spectroscopy (NIRS) was placed 1cm above right orbital to record prefrontal cortex hemodynamic data, while finger plethysmography was used to obtain continuous arterial blood pressure (ABP) from the left middle distal phalynx. NIRS and ABP data were used to calculate THx (total hemoglobin index reactivity in response to a change in ABP), and TOxa (tissue oxygenation index reactivity in response to a change in ABP) (Zweifel et. al 2014). Repeated measures ANOVA and t-tests ($p<0.05$)

were conducted to statistically analyze differences between CC and NC for rest, BOPT, and recovery phases, with Bonferroni correction applied.
Results
THx was significantly increased during CC-BOPT (NC = 0.185 ± 0.025; CC = 0.215 ±0.036). TOxa and ABP showed no statistically significant differences between conditions for BOPT (NC-ABP = 81.9±2.2mmHg; CC-ABP= 82.4±2.2mmHg, NC-TOxa = 0.83±0.03; CC-TOxa = 0.82±0.03). Rest and recovery phases showed no significant differences between NC and CC conditions.
Discussion
This pilot data suggests that mild compression increased THx without changing the metabolic rate for oxygen in the brain. Increased THx at BOPT suggests that total hemoglobin volume was altered, as TOxa and ABP did not change. Further research is needed to confirm the effect of continuous mild compression on cerebral hemodynamics and to investigate if adding exercise to our protocol will result in adverse effects.
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Contact:
dech200r@uregina.ca

POST-EXERCISE ELEVATION IN SERUM IRISIN LEVELS DO NOT MODULATE DIET-INDUCED THERMOGENESIS IN HEALTHY YOUNG ADULTS

NAGHAVI, N.

RESEARCH CENTER FOR URBAN HEALTH AND SPORTS OSAKA CITY UNIVERSITY

Introduction
Physical activity is one of the determinants of energy expenditure. Exercise increases daily energy expenditure, which may be derived from the increase in resting energy expenditure or diet-induced thermogenesis (DIT). Plasma irisin levels increase after acute exercise in mice and humans. Therefore, exercise-induced irisin may increase DIT.
Methods
Nine healthy young subjects (32 ± 4 years) participated in exercise (EX) and no exercise (NOEX) trials performed in a random order. In the exercise trial, 40 min of exercise on a bicycle ergometer at 60% of the heart rate reserve were performed on the day before the assessment of energy expenditure. Blood concentrations of irisin, glucose, and insulin were measured before and after the intake of a fixed 860 kcal meal. Serum irisin levels were also examined before and immediately after the 40-min exercise.
Results
Postprandial irisin levels were higher in the EX trial than in the NOEX trial. Dietary intake did not affect serum irisin levels in either trial. No differences were found in postprandial glucose and insulin levels between the trials.
Discussion
We concluded that the elevation in serum irisin levels induced by a single bout of exercise did not modulate resting EE and DIT. In a previous study, acute exercise also failed to increase DIT, and our result was consistent with those. It may take a certain time period to enhance responsiveness to β-sympathetic stimulation by exercise training.
Contact
Nooshin@med.med.osaka-cu.ac.jp

EFFECTS OF WATER IMMERSION IN VARIOUS WATER LEVELS ON URINE VOLUME AND SUBJECTIVE MICTURITION DURING WATER EXERCISE IN WOMEN

WADA, T.1, NOSE, Y.2, YOSHIOKA, A.3, ONODERA, S.1

1)KAWASAKI UNIVERSITY OF MEDICAL WELFARE, 2)YASUDA WOMEN'S UNIVERSITY, 3)OKAYAMA UNIVERSITY

Purpose
This study aimed to investigate the relationship of in water exercise with urine volume, subjective micturition, rating of perceived exertion (RPE), heart rate, blood pressure, and rectal temperature during in water exercise.
Methods
Nine healthy female subjects (age: 22.0 ± 0.6 years, weight: 52.5 ± 5.5 kg, height: 156.2 ± 3.9 cm) volunteered for this study. Each subject signed an informed consent form. The study was conducted in an indoor pool facility at the K University. This study comprised two experimental conditions: the clavicle trial (C) and the greater trochanter trial (G). The water levels were set to the level of a human clavicle and that of a human greater trochanter process. Subjects participated in both conditions on different days. Measurement items were urine volume, subjective micturition, RPE, heart rate, blood pressure (SBP: systolic blood pressure/DBP: diastolic blood pressure), and rectal temperature. The water temperature was 30°C. Subjects under both conditions began with 30 minutes in a sitting posture on land. Then, for the next 30 minutes, subjects under both conditions performed aquatics in the water. Finally, for the last 30 minutes, subjects under both conditions were back on land in a sitting posture.
Results
Urine volume and subjective micturition after immersion was higher in the C condition than in the G condition ($p < 0.05$). Heart rate at immersion and recovery at 5 minutes were higher in the C condition than in the G condition ($p < 0.05$). RPE at immersion was higher in the C condition than in the G condition ($p < 0.05$). Rectal temperature at immersion and recovery at 5, 10, and 15 minutes were lower in the C condition than in the G condition ($p < 0.05$). SBP and DBP at immersion were higher in the C condition than in the G condition ($p < 0.05$).
Discussion
Venous return increases in water and urine formation rises, and the diuretic effect then increases. Previous studies demonstrated that responses to physical characterizations in water differed from those on land. Conclusion: Urine volume and subjective micturition increase through immersion in water.
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IDENTIFICATION OF PHYSIOLOGICAL PARAMETERS FOR ESTIMATING CYCLING AND RUNNING PERFORMANCE IN A TRIATHLON

KEI, T., TAKAMASA, T., SHUICHI, M., HISASHI, N.
JUNTENDO UNIVERSITY

Purpose
The purpose of the present study was to identify physiological parameters for estimating cycling and running performance in a triathlon.
Methods
Eight male collegiate triathletes (total time: 2:11'40±08'40, cycling time of triathlon: 1:05'49±02'31, running time of triathlon: 41'47±04'18) volunteered to participate in the current study. Subjects performed the incremental exercise test to measure maximum oxygen uptake (VO2max), ventilatory threshold (VT), lactate threshold (LT) and onset of blood lactate accumulation (OBLA) using both a cycle ergometer and a treadmill. Maximal voluntary knee flexor/extensor muscular strength was also measured using a Biodex system 3 isokinetic dynamometer. Pearson's product-moment correlation coefficient was determined and a stepwise multiple regression was performed to identify the independent variables that best estimate the cycling and running time in a triathlon for the subjects as a whole.
Results
Significant correlations between cycling performance and VO2max, OBLA, VT and maximal voluntary isometric knee flexor/extensor muscular strength were observed ($p<0.05$). Moreover, maximal voluntary isometric knee extensor muscular strength and OBLA were used to estimate the cycling time of a triathlon (cycling time of triathlon =89.549−0.068×[maximal voluntary isometric knee extensor muscular strength]−2.687×[OBLA]). Conversely, there was only a correlation between maximal voluntary isometric knee extensor muscular strength and the running time of a triathlon ($p<0.05$).
Conclusion
These findings suggest that the important physiological parameter for estimating both the cycling and running performance of a triathlon is the maximal voluntary isometric knee extensor muscular strength in collegiate triathletes.

EXERCISE RESTORES THE DECREASED AUTOPHAGY IN HIPPOCAMPUS OF LACTATIONAL DEHP-EXPOSED RATS

YU, H.F., LEE, Y.C., WANG, D.C.
KAOHSIUNG MEDICAL UNIVERSITY

Introduction
The autophagic process is a lysosomal degradation pathway, which is activated during stress conditions, such as starvation or exercise. Regular exercise has beneficial effects on human health, including neuroprotection, by enhancing the expression of brain-derived neurotrophic factor (BDNF) (Singh and Staines, 2015). However, early life exposure to di-(2-ethylhexyl)-phthalate (DEHP), a plasticizer usually applied in polyvinyl chloride manufacture, may impair the expression of BDNF and neuronal function in rats (Smith and Holahan, 2014). In this study, an attempt is made to evaluate whether autophagy is interfered by lactational DEHP exposure, and whether exercise can restore this interference.
Methods
Rat dams were fed with vehicle or DEHP (10 mg/kg per day) during lactation. After weaning, the male offspring were divided into 4 groups: control (C), DEHP (D), exercised control (Cex), and exercised DEHP (Dex). Rats were trained to exercise on a treadmill for 6 months from the ages of 18 months to 24 months. At the age of 24 months, animals were sacrificed and the expression of Atg12 as well as LC3-II/LC3-I ratio in the hippocampus were determined by western blotting.
Results
No significant difference was found in the expression of Atg12 among groups. However, LC3-II/LC3-I ration was decreased in the D group, indicating that neonatal DEHP exposure may reduce the function of autophagy in the hippocampus. After the five-week aerobic exercise training program, the performance of autophagy was improved in the Dx group.
Discussion
Our results indicated that the autophagic machinery is impaired in the hippocampus of lactational DEHP-exposed rats, and regular exercise during childhood-adolescent period can restore the autophagic machinery in the hippocampus. Given the findings of this study, it is proposed that aerobic exercise may provide beneficial effects on ameliorating the altered biochemical and neurobehavioral outcomes in lactational DEHP-exposed young adult rats.
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EXERCISE RESTORES THE ENHANCED AUTOPHAGY IN CEREBELLUM OF LACTATIONAL DEHP-EXPOSED RATS

FAN, C.T., LEE, Y.C., WANG, D.C.
KAOHSIUNG MEDICAL UNIVERSITY

Introduction
The autophagic process is a lysosomal degradation pathway, which is activated during stress conditions, such as starvation or exercise. Regular exercise has beneficial effects on human health, including neuroprotection, by enhancing the expression of brain-derived neurotrophic factor (BDNF) (Singh and Staines, 2015). However, early life exposure to di-(2-ethylhexyl)-phthalate (DEHP), a plasticizer usually applied in polyvinyl chloride manufacture, may impair the expression of BDNF and neuronal function in rats (Smith and Holahan, 2014). In this study, an attempt is made to evaluate whether autophagy is interfered by lactational DEHP exposure, and whether exercise can restore this interference.
Methods

Rat dams were fed with vehicle or DEHP (10 mg/kg per day) during lactation. After weaning, the male offspring were divided into 4 groups: control (C), DEHP (D), exercised control (Cex), and exercised DEHP (Dex). Rats were trained to exercise on a treadmill for 6 months from the ages of 18 months to 24 months. At the age of 24 months, animals were sacrificed and the expression of Atg12 as well as LC3-II/LC3-I ratio in the cerebellum were determined by western blotting.
Results
No significant difference was found in the expression of calbindin D28K among groups. However, Atg12 and LC3-II/LC3-I ration were increased in the D group, indicating that neonatal DEHP exposure may enhance the autophagic machinery in the cerebellum. After the five-week aerobic exercise training program, the performance of autophagy was normalized in the Dx group.
Discussion
Our results indicated that the autophagic machinery is enhanced in the cerebellum of lactational DEHP-exposed rats, and regular exercise during childhood-adolescent period can restore the autophagic machinery in the cerebellum. Given the findings of this study, it is proposed that aerobic exercise may provide beneficial effects on ameliorating the altered biochemical and neurobehavioral outcomes in lactational DEHP-exposed young adult rats.
References
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AEROBIC EXERCISE AMELIORATES THE IMPAIRED MOTOR COORDINATION IN LACTATIONAL DEHP-EXPOSED RATS

HO, T.H., LEE, Y.C., WANG, D.C.
KAOHSIUNG MEDICAL UNIVERSITY

Introduction
Aerobic exercise can improve learning and memory by enhancing the expression of brain-derived neurotrophic factor (BDNF) (Singh and Staines, 2015). Early life exposure to di-(2-ethylhexyl)- phthalate (DEHP), a plasticizer usually applied in polyvinyl chloride manufacture, may impair the expression of BDNF in rats (Smith and Holahan, 2014). In this study, an attempt is made in the present study to evaluate the effects of exercise on ameliorating the neonatal DEHP exposure-induced neural dysfunction in young adult rats.
Methods
Rat dams were fed with vehicle or DEHP (10 mg/kg per day) during lactation. After weaning, the male offspring were divided into 4 groups: control (C), DEHP (D), exercised control (Cex), and exercised DEHP (Dex). Rats were trained to exercise on a treadmill for 6 months from the ages of 18 months to 24 months. At the age of 24 months, animals were subjected to rotarod test and catwalk test for assessment of motor coordination and gait analysis, respectively, followed by ELISA measurement of plasma and cerebellar BDNF contents.
Results
No significant difference was found in gait analysis among groups. Deficit of motor coordination, as well as reduced plasma and cerebellar BDNF levels were observed in the D group. These results indicated that neonatal DEHP exposure may reduce the release of BDNF, leading to dysfunction of the cerebellum. After the five-week aerobic exercise training program, the performance of motor coordination was improved and plasma BDNF level was increased in the Dx group.
Discussion
Early-life exercise can enhance capacity to evoke memories and reduced risk of neurodegenerative diseases in later life. This long-term effects of exercise-induced BDNF release can maintain the structure and function of central nervous system, suggesting that exercise may be a useful method to ameliorate the adverse effects caused by insults in early life. Given the findings of this study, it was proposed that aerobic exercise may provide beneficial effects on ameliorating the altered biochemical and neurobehavioral outcomes in lactational DEHP-exposed young adult rats.
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PHYSICAL ACTIVITY PREVENTS HEPATIC AND PANCREATIC MORPHOLOGICAL DERANGEMENTS INDUCED BY A FAT DIET AND SEDENTARISM MODEL IN RODENTS.

BOVOLINI, J.A., ROLIM FILHO, N., CARDOSO, D., ANDRADE, M.A., DUARTE, J.A.
(1) SPORT FACULTY, UNIVERSITY OF PORTO, PORTUGAL; (2) FEDERAL UNIVERSITY OF PERNAMBUCO, BRASIL.

Introduction
Different metabolic and morphological disorders can be caused by high fat intake and sedentarism. Likewise, physical activity is an efficient tool in prevention and treatment of the main pathologies derived from sedentary lifestyles. Considering its potential protective capacity, we seek to observe the physical activity effect on morphological derangement caused by sedentarism and fat intake in pancreas and liver, essential organs in metabolic balance and health.
Methods
40 Wistar four-week-old rats, divided into four groups: sedentary maintenance diet (SMD, n=10), active MD (ASD, n=10), sedentary fat diet (SFD, n=10) and active FD (AFD, n=10), and fed for 21 weeks with a fat (70% of calories from fat; Research Diets) or a maintenance diet. Active groups had unrestricted free wheel access to physical activity practice while sedentary groups remained restricted to cage space. At the end of the protocol, the animals were weighed, euthanized and pancreas and liver samples were collected for histological analysis. The samples were stained with Hematoxylin-Eosin to evaluate hepatic fat deposition and Langerhans islets cross-sectional area (CSA) and Sirius Red protocol to evaluate collagen deposition. Then, the samples were photographed with a light microscope connect to a digital camera (Carl Zeiss) and analyzed with NIH ImageJ software (USA) to evaluate of fat tissue deposition and CSA. For collagen quantification was used the software Image Pro Plus 6.
Results
No significant differences in body weight were found between groups. Both groups FD-fed had a hepatic and pancreatic weight reduction ($p<0.005$ vs. SMD) with a significant collagen deposition in both organs ($p<0.005$ vs. SSD, AMD and AFD). SFD group also presented an expressive Langerhans islets CSA increased ($p<0.005$ vs. SSD, AMD and AFD). The AFD group shows a hepatic and pancreatic collagen deposition, as well endocrine pancreas CSA similar to SMD group ($p<0.05$ vs SFD).

Conclusion
The results suggest that the daily high fat consumption has significant and deleterious effects on pancreas and liver histological profile, even without relevant clinical manifestation as overweight. It also suggests that the sedentary lifestyle seems to amplify the tissue damage induced by fat consumption, making it a pathogenic combination. However, physical activity proved to be effective in reversing the histological derangements caused by diet and sedentary lifestyle, demonstrating that an active lifestyle seems to be an effective preventive and therapeutic tool.

REDUCED INTEGRATED EMG DURING 40 KM CYCLING TIME TRIAL IN HYPERTHERMIA

NEARY, J.P., SCHAERZ, S., DAHLSTROM, B.K.

UNIVERSITY OF REGINA (REGINA, CANADA); UNIVERSITY OF LETHBRIDGE (LETHBRIDGE, CANADA)

Introduction
Exercise in the heat can significant tax the body's neuromuscular system. It has been suggested that the degree of muscle activation can be used to reflect peripheral fatigue (Thomas et al, 2015). We hypothesis that there would be a direct relationship between decrements in iEMG activity and power output (PO) during heat stress when performing a 40 km time trial (40TT).
Methods
Twleve (n=2 female) triathletes performed a 40TT on a Velotron cycle ergometer under control (CON, 18°C) and hyperthermic (HYP, 40°C) conditions in an environment chamber. Muscle activation of the vastus lateralis (iEMG activity, percent of peak signal intensity at peak VO2max power output - %PP), power output (PO, Watts), heart rate (HR, bpm), and Borg Rating of Perceived Exertion (RPE) were recorded and averaged over a one minute period every five kilometers. Dependent paired t-tests compared differences between CON and HYP with statistical significance set at $p<0.05$.
Results
Results showed that mean (±SD) PO was significantly reduced in the HYP (175.0±48.6 W) vs. CON (227.6±57.1W) condition, and this reflected the slower time (-22%) to complete the 40TT during HYP (1:17:21±07:39) vs. CON (1:10:06 ±06:48). Mean iEMG activity was significantly different between trials (CON 36.4±19.9 vs 27.3±9.4 %PP), with iEMG activity being significance lower at 20, 30, 35 and 40km in HYP compared to CON. PO and iEMG activity was significantly correlated for CON (r=.443) and HYP (r=.347) throughout the 40TT. Heart rate was not significantly between trials, nor was the RPE/HR ratio. PO and iEMG were significantly increased during the final 5 kms during CON (31.7%; 20.7%, respectively), but only PO was increased during HYP (10.3%; 1.86%, respectively).
Discussion
The degree of muscle activation of the vastus lateralis was found to be significantly influenced by heat, likely contributing to the reduced 40TT performance. The current observation that iEMG activity and PO increased concomitantly in the last 5km of the CON 40TT is considered significant; whereas the change in PO and iEMG activity during the HYP did not follow the same pattern, i.e., iEMG did not change while PO increased. We hypothesis that this may reflect the presence of a neuromuscular reserve despite a conscious effort by all subjects to perform maximally during the self-paced 40TT's as evidenced by the HR:RPE ratio being the same between trials. The reduced iEMG supports a reduced neuromuscular activation during exercise hyperthermia contributing to peripheral and likely central fatigue (Thomas et al, 2015).
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Contact
patrick.neary@uregina.ca
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LEG TEMPERAURE AND CREATINE KINASE CHANGES IN SPRINTERS DURING AN 11-DAY TAPERING PERIOD

ZIELIŃSKI, J., KORMAN, P., KANTANISTA, A., STRABURZYŃSKA-LUPA, A., KUSY, K.

POZNAN UNIVERSITY OF PHYSICAL EDUCATION

Introduction
Intensive high performance training triggers inflammatory processes which generate heat due to increased local metabolism, hence they can be measured using the temperature gradient. Simultaneously training causes muscle injury and secretion of creatine kinase (CK). So far there has been a lack of research which correlates CK level and surface temperature in the training process (Bendeira F et al., 2012). Therefore, the aim of this study was to observe surface temperature changes and CK levels in highly trained sprinters during the tapering period.
Methods
Eighteen elite sprinters (9-male, 8-female), age range 21-31 years, were studied during an 11-day training camp in Monte Gordo (Portugal). Every morning, capillary blood samples were drawn to assay CK level. At the same time lower limb surface temperature was measured and thermal images were taken using an infrared camera. Statistical analysis was carried out to show the relationship between limb temperature and CK level.
Results
From the first day, baseline temperature levels started to decrease both in male (33,7±0,4°C) and female (32,8±0,6°C) athletes. In the male group, temperature levels declined until the 7th day (32,0±0,4°C; $p<0.01$) and stabilized till the end of the training camp. In the female group temperature levels declined till the 8th day (31,2±0,7°C; $p<0.01$) and stabilized until the last day. Simultaneously in both groups CK level increased from the first until the last day of training in male (236,1±121U/L vs 424,0 ±130,9 U/L) and female (144,2±65,1 U/L vs 211,3 ±25,8 U/L) athletes respectively.
Discussion
Day by day temperature declined in both groups suggesting a physiological reaction to the training loads. The temperature stabilization after 7 days in male and 8 days in female athletes might suggest adaptation to consecutive training sessions. Despite the fact that there was no statistically proven correlation between temperature and CK level we observed that CK level increased concurrently with temperature decline.
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Contact: jacekzielinski@wp.pl

DEVELOPMENT OF A VO2PEAK PREDICTION EQUATION IN ELDERLY

PERALTA-BRENES, M., BRICEÑO-TORRES, J., CHACÓN-ARAYA, Y., MONCADA-JIMÉNEZ, J., SALAZAR-VILLANEA, M., JOHNSON, D., CAMPOS-SALAZAR, C.

1. UNIVERSITY OF COSTA RICA 2.UNIVERSITY OF KANSAS

Introduction

Aging decreases aerobic capacity as determined by direct maximal tests (Hassel et al. 2015). There are indirect methods to assess aerobic capacity such as the 6-min walking test (6MWT). Some equations to predict aerobic capacity have been developed from the 6MWT distance; however, there are no equations to predict aerobic capacity in Latin American elderly. Therefore the purpose of this study was to develop an equation to predict peak aerobic capacity (VO2peak) from the 6MWT and anthropometric variables in functional Costa Rican elderly.

Methods

Participants were 79 Costa Rican functional elderly (69.5 ± 24.5 yr.). Volunteers were excluded if they presented gait problems. Anthropometric measures included body height, weight, body mass index (BMI), and body fat percentage as measured by dual-energy X-ray absorptiometry. Indirect calorimetry was used to determine VO2peak on a graded exercise test using the modified Balke protocol, and the 6MWT (Rikli & Jones, 1998) to determine total walking distance. Statistical analyses included Pearson's correlation, repeated measures t-student, Lin's concordance coefficient and Bland-Altman, and multiple linear regression.

Results

The regression equation for Costa Rican elderly from predictor variables is VO2peak = 17.59 + 0.028 (6MWT in meters) – 0.256 (BMI) - 2.567(Gender), with an R2 = 0.48 and a standard error of estimation (SEE) = 3.25 ml/kg min. No significant differences between predicted (23.26 ± 3.08 ml/kg min) and measured (22.95 ± 4.45 ml/kg min) VO2peak values were found ($p > 0.05$). A high correlation between predicted and measured VO2peak values was obtained ($r = 0.70$, $p < 0.01$); however, there was a poor concordance between tests according to Lin's coefficient ($r = 0.61$).

Discussion

Some variables like the body adiposity (Carpio-Rivera et al. 2015), 6MWD (Fernandes et al. 2016) or the VO2max cannot be predicted using reference equations derived from different kind of populations. The new equation to predict aerobic capacity in Costa Rican elderly explains 48% of the variance and has an acceptable predictive error.

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Contact

marianapbrenes@gmail.com /mariana.peraltabrenes@ucr.ac.cr

SIMILAR ACUTE-EXERCISE-INDUCED EFFECTS OF AEROBIC VERSUS RESISTANCE EXERCISE ON ADIPONECTIN AND LIPIDS 30 MINUTES POST-EXERCISE

ROCHE, D.M.1, SMITH, M.1, WELLS, M.1, OTU, L.1

LIVERPOOL HOPE UNIVERSITY

Introduction

Adiponectin is an adipocyte-secreted hormone with anti-atherosclerotic, anti-diabetic and anti-inflammatory properties. Thus far, research into the acute-exercise-induced enhancement of adiponectin concentration following aerobic exercise has been inconsistent (Simpson & Singh, 2008), possibly due to samples being taken immediately post-exercise. Resistance training has shown more promise as a means to increase adiponectin concentration after 1 session (Varady et al., 2010), but has not been widely utilised as an exercise mode in studies on healthy, recreationally active individuals. The aim of this study was to examine and compare the acute-exercise-induced effects of aerobic versus resistance exercise on adiponectin concentration and lipid profiles at a delayed point in recovery; 30 min post-exercise.

Methods

Ten young, healthy, normoglycaemic and normolipidaemic males (mean age: 26.1 ± 5 years; height: 179 ± 6 cm; body mass 79.1 ± 9.2 kg; BMI 24.7 ± 3.0 kg/m2; means ± SD.) performed two acute exercise trials: aerobic (AER) and resistance (RES), randomised in order and matched for total energy expenditure. AER consisted of 30 minutes cycling at 70% VO2max and RES, ~30 minutes of resistance exercise at 70% 1RM. Both trials were completed within the same week with at least 48 hours separation. Venous and capillary samples were collected at rest and 30 minutes post-exercise for determination of serum adiponectin and lipid profiles.

Results

Within both the AER and RES trials, there was a significant drop in serum adiponectin concentration from baseline to 30 minutes post-exercise (AER: 27.1 ± 9.6 µg/ml vs 25.3 ± 11.1 µg/ml; $p=0.04$; RES: 26.8 ± 10.0 µg/ml to 25.4 ±10.7 µg/ml, $p=0.04$). There was no significant main effect of mode of exercise (AER vs RES) on the change in serum adiponectin concentration between these two time points ($p>0.05$). No differences were found, with respect to time or mode, for HDL-C, LDL-C, triglycerides, or total cholesterol.

Discussion

These findings suggest that serum adiponectin concentration remains attenuated compared to its pre-exercise value 30 minutes into recovery, following either acute AER or RES exercise and the two exercise modes do not differ in their effect on lipids. One bout of acute RES or AER exercise will not improve adiponectin expression in healthy, recreationally active males within this time-frame. Further research should focus on determining the temporal sequence of adiponectin responses to acute exercise in an extended post-exercise phase.

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STIMULATION EFFECT BY HIGH FREQUENCY ON MECHANICAL PROPERTIES IN THE ELBOW FLEXOR MUSCLES.

HIRATSUKA, K.1, MIYAZAKI, D.1, DJORDJEVIC, S.2, TSUNODA, N.1.

1: KOKUSHIKAN UNIVERSITY (TOKYO, JAPAN), 2: UNIVERSITY OF PRIMORSKA (KOPER, SLOVENIA)

Introduction
In recent days, stimulation provided by various high frequency apparatus is often used for athletes in better conditioning, whereas we see very less report of its clinical advantage. The aim of this report is to clarify the effect of stimulation by high frequency on the mechanical properties and the muscle function in the skeletal structures in the fatigue condition.
Methods
Subjects were 22 healthy male university students. Both high frequency (HS) and non-stimulation as a control condition (CON) were offered to them. Muscle fatigue was produced by 50 times repetition of maximum isometric elbow flexions. Tecnosix-Red Coral was used for producing high frequency stimulation. High frequency stimulation of 750KHz at 60W power output was generated in 15 minutes, after the 50 times maximum isometric elbow flexions were completed. Skin temperature was monitored by an infrared thermography (INFRA-EYE 1200). Muscle mechanical properties on biceps brachii (BB) were assessed by a Tensionmyography (TMG method). A contraction time (Tc) and maximal displacement of the muscle belly (DM) were measured as parameters for the mechanical properties (Dahmane et al., 2001). In addition, normalized velocity (Vrn) was also analyzed (Rodríguez-Ruiz et al., 2014). Skin temperature, maximum isometric elbow flexion (MVC) and the muscle mechanical properties were measured before the 50 times contractions were performed (Pre), right after the performance was over (Post), and after following 30 min recovery period (Rec).
Results
Skin temperature of HS (35.6±0.7°C) in Rec was significantly higher than that of CON (33.4±0.4°C). In Tc, Rec of HS (26.5±3.2ms) was significantly faster than CON (28.8±2.8ms). Vrn of HS (30.6±3.7mm/s) in Rec was significantly higher than that of CON (28.0±2.7mm/s). Significant difference of Dm was observed between HS (12.5±2.2mm) and CON (10.9±2.2mm) in Rec. MVC of HS was significantly recovered from Post to Rec (37.1±6.4%). Also, in Rec, MVC on HS (54.4±15.5Nm) showed a significantly higher value than that of CON (44.5±11.5Nm).
Discussion
In this study, it was found, that HS was significantly more effective for the recovery of the muscle fatigue caused by MVC and the muscle mechanical properties in comparison with CON. From these results, it was suggested that stimulation by high frequency may produce better protection and earlier recovery against long lasting muscle fatigue.
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Contact
hiratsuk@kokushikan.ac.jp

RELATIONSHIP BETWEEN ACUTE CHANGES IN FMD AND VO2 MAX IN HEALTHY MEN

DAWSON, E.A., ERSKINE, R., GREEN, D.J., THIJSSEN, D.H.J.

LIVERPOOL JOHN MOORES UNIVERSITY

Introduction
There is growing interest examining the immediate changes in vascular function following an acute bout of exercise. However, there is disparity in the literature with an increase, decrease and no change in FMD immediately following exercise reported. An immediate decrease may represent either a training stimulus or a transient period of acute risk or endothelial fatigue. It has been suggested that fitness can moderate the acute FMD response to acute exercise. Therefore, the aim of the study was to determine if the acute change in FMD following cycling exercise was related to VO2max.
Methods
Vascular function was assessed in healthy young men using brachial artery flow-mediated dilation (FMD) both before and immediately after a 30-min exercise endurance cycling exercise bout at 70% VO2 max (n=27, 20.9±2.7 yr, 76.3±9.3 kg, 180±6 cm). To explore the impact of fitness on the acute responses a VO2 max test was carried out on a cycle ergometer at least 2 days prior to the acute exercise bout.
Results
There was no significant change in FMD% pre-immediately post exercise (6.9±3.1% to 6.3±2.4%). There was a wide variety in acute responses from a delta change from -5.0 to 9.0%. VO2 max was 47.6±8.6 ml/kg/min ranging from 32.1 to 62.7 ml/kg min. There were significant increases in baseline and peak artery diameter, SRauc and time to peak dilation ($p<0.05$). However, statistically correcting for baseline diameter and SRauc did not change the findings. There was no significant correlation between resting FMD and VO2 max ($r=0.2$, $p=0.3$).
Conclusion
Our data suggest that 30 mins of cycling at 70% VO2 max did not significantly change brachial artery FMD% in healthy young men. In contrast to our hypothesis, the degree of change within individuals was not associated with fitness as determined by cycling VO2max. The fitness of most of the subjects may have result in a relatively robust anti-oxidant status. It is possible that a greater exercise intensity and/or a wider range of fitness levels may be necessary to see a relationship between fitness and acute changes in FMD. These data suggest that a moderate-intense exercise does not decrease FMD in health young males, and that the range of response was not related to aerobic fitness.

LIFELONG COMPETITIVE TRAINING ATTENUATES OXIDATIVE STRESS IN MASTER ATHLETES OF DIFFERENT MODALITIES.

AGUIAR, S., SOUSA, C.V., SIMÕES, H.G.

CATHOLIC UNIVERSITY OF BRASÍLIA

Objective
To investigate and compare oxidative stress in master athletes of different modalities, healthy young and sedentary adults.
Methods
Blood samples were collected from 17 young controls (22.7 ± 7.0 yrs old), 12 middle-aged controls (45.5 ± 9.9 yrs old), 18 long-distance master athletes (53.0 ± 8.2 yrs old), 13 sprint master athletes (50.0 ± 8.9 yrs old) and 10 martial arts master fighters (46.1 ± 7.0 yrs old).

Totalizing a sample size of seventy (n = 70). Blood samples were centrifugated and serum underwent lipid peroxidation analysis (TBARS) to assess a pro-oxidant parameter and superoxide dismutase (SOD) activity by spectrophotometry.
Results
No significant differences were observed in TBARS concentrations between the groups investigated (p> 0.05). SOD activity was significantly lower (p <0.05) in the middle-age control group than in the young control group and long-distance runners (35% and 32%, respectively). In addition, the middle-age control group had significantly lower values (p <0.05) for the SOD/TBARS ratio than the long-distance group (about 44%).
Conclusions
The results suggest that the lifelong running practice seems to preserve the response to oxidative stress. Through the findings of this study, we believe that lifelong competitive training may reflect the improvement in quality of life during aging.

NO IMPACT OF HIGHER VIGOROUS PHYSICAL ACTIVITY ON VASCULAR HEALTH, CARDIORESPIRATORY FITNESS OR BODY COMPOSITION IN ACTIVE ADULTS

HOPKINS, N.

LIVERPOOL JOHN MOORES UNIVERSITY

Introduction
It is widely accepted that there is a dose response relationship between physical activity (PA) and cardiovascular (CV) risk. However, as the shape of the dose response curve is still poorly defined, how increasing PA time and intensity in already active individuals' impacts CV risk remains unclear. We therefore sought to determine whether engaging in higher habitual vigorous PA (VPA) has additive cardiovascular health impacts in healthy adults who already meet minimum moderate physical activity (MPA) recommendations of 150 minutes/week.
Methods
Twenty-five healthy, active participants (aged 27.9 ± 8.2 years, 16 males) were recruited. Physical activity was objectively measured for seven days via accelerometry. Cardiovascular risk measurements included: Body fat percentage (%) as determined by bioelectrical impedance; cardiorespiratory fitness (CRF; VO2peak) assessed on a treadmill using the modified Bruce protocol; and brachial and femoral artery flow-mediated dilation (FMD) and left common carotid artery intima-media thickness (cIMT) assessed via high resolution ultrasound. Participants were ranked according to weekly VPA time, and the cohort was split into 2 groups: those in the <50th percentile (LoVPA, N=12) and those >50th percentile for VPA (HiVPA, N=13). Independent t tests were used to determine differences in CV risk variables between groups.
Results
Groups differed significantly for the amount of weekly VPA (LoVPA 18.92+17.85 min; HiVPA 134.15+65.22 min, p<0.001) and MVPA (LoVPA 384.91+115.83 min; HiVPA 534.84+117.81 min, p=0.01), but not for light PA, MPA, or sedentary behaviour (p>0.05). Additionally, there were no differences (p>0.05) between groups for body fat % (LoVPA 20.5+7.5%; HiVPA 23.7+9.8%), VO2peak (LoVPA 48.37+10.65%; HiVPA 46.33+7.48%), femoral FMD (LoVPA 6.56+3.08%; HiVPA 7.15+3.47%), brachial FMD (LoVPA 6.81+2.33%; HiVPA 6.40+2.76%), or cIMT (LoVPA 0.57 +0.08mm; HiVPA 0.56+0.05mm).
Discussion
In this cohort of active, young adults there were no differences in the body fat, cardiorespiratory fitness or conduit artery structure and function of those engaging in higher levels of VPA compared to those engaging in lower levels of VPA. The World Health Organisation state that 150 minutes VPA/week provides additional health benefits, yet few participants in the current study achieved this, participants may therefore have completed insufficient amounts of VPA to modify CV risk variables. Future work is needed to define the cardiovascular benefits of PA at the higher end of the dose response curve.

PRELIMINARY RESULTS: AEROBIC EXERCISE INCREASES LEPTIN LEVELS IN WHITE AND BROWN ADIPOSE TISSUES

GENCOGLU, C.1, AKSU, I.2,3, GUVENDI, G.2, GUMUS, H.1, SISMAN, AR.4, KIRAY, M.2,3, UYSA, N.2,3.

DOKUZ EYLUL UNIVERSITY (IZMIR, TURKEY)

Introduction
It is well known that leptin hormone regulates appetite and increases fatty acid usage from adipose tissue. Both short and long term voluntary running wheel exercise reduced mRNA leptin expression in white adipose tissue WAT (Gollisch et al., 2009). Along with skeletal muscle, brown adipose tissue (BAT) is one of most important site for nonshivering thermogenesis that causes high-energy consumption (Sanchez et al., 2015). Therefore purpose of this study is to investigate the effects of regular aerobic exercise on leptin levels in white and brown adipose tissues.
Methods
Sixteen male young (eight weeks old) Wistar Albino rats were randomly assigned into exercise (n=8) and control groups (n=8). After treadmill running acclimatization period (5 m/min 0° slope, for 10 min/day, 5 days for a week), exercise group performed moderate running on the treadmill at a speed of 8 m/min, 30 min every day for, 5 day/week for 6 weeks. Control group was taken to the training room and subjected to identical handling. WAT and BAT homogenates and serum leptin levels were determined by a radioimmunoassay method.
Results
Both BAT and WAT leptin levels decreased in exercised rats compared with control. Serum leptin levels were unaffected from exercise. In addition, there are moderate positive correlation between BAT and WAT leptin levels (r= 0.638, p= 0.014).
Discussion
Our findings observed that exercise decreases leptin levels in the both BAT and WAT. Along with unaffected serum leptin suggest that the reduction of adipose tissue leptin levels can be result of exercise induced fat mass loss. Although the present study has limitation that fat-cell size was not evaluated yet. BAT promotes a thin and healthy phenotype and improves insulin sensitivity. Because of BAT has a regulatory role on energy metabolism, leptin levels of BAT may have critically importance.
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Contact
celal.gencoglu@deu.edu.tr

Psychology

DOES DAILY EXERCISE MODERATE THE EFFECT OF SENSORY-PROCESSING SENSITIVITY ON DEPRESSIVE TENDENCY?

YANO, K., KIMURA, S., OISHI, K.

RIKKYO UNIVERSITY

Introduction
Sensory-processing sensitivity (SPS) is the trait that refers to the extent in which individuals deeply process information. It has been suggested that SPS was related to depressive tendency. In contrast, a lot of previous studies have showed that daily exercise moderated depressive tendency. This study aimed to examine the relationships among the levels of daily exercise, SPS, and depressive tendency.
Methods
The participants were 275 university students in Japan (135 males and 140 females; aged 19.4 ± 1.1 years). They were investigated the following items: 1) the frequency of daily exercise (per week), 2) 19 items of the Japanese version of Highly Sensitive Person Scale (HSPS; Takahashi, 2016), and 3) the Japanese version of Self-rating Depression Scale (Fukuda & Kobayashi, 1973). HSPS was consisted of three factors, i.e., "low sensory threshold", "ease of excitation", and "aesthetic sensitivity". We conducted the structural equation modeling (SEM) to examine the hypothesis model of the effect of SPS on depressive tendency through daily exercise. Statistical analyses were conducted using IBM SPSS (version 21) and IBM Amos (version 21).
Results
SEM showed that the scores of HSPS negatively contributed to the frequency of daily exercise and positively to SDS scores. Additionally, the frequency of daily exercise negatively contributed to SDS scores. Fit indexes for the structural model were good: $x2$ (1) = 3.16, p =.075; GFI =.994; AGFI =.943; RMSEA =.089. The significance of the indirect effect was estimated by using the bootstrap method. The number of bootstrap samples was 2000. The result showed the indirect effect from the scores of HSPS to SDS scores through daily exercise was significant (p <.01; 95%CI [0.02, 0.12]).
Discussion
This result showed the possibility that the daily exercise partially moderated the effect of SPS on depressive tendency. It was suggested that higher SPS persons might be retain and/or improve mental health by daily exercise. Hereafter, it is needed to examine the relationships between SPS and various psychological factors, such as life skills and stress copings.
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Contact
kosuke.yano1012@gmail.com

ATTENTIVELY TRACKING MULTIPLE MOVING OBJECTS IN BALL SPORT ATHLETES AND NON-ATHLETES

WU, S.K., CHIANG, C.H., YANG, S.H., CHEN, W.Y.

NATIONAL TAIWAN UNIVERSITY OF SPORT

Introduction
Playing a small and dynamic ball sport always involves tracking a fast moving ball. Baseball players need to track the fast moving balls, the running teammates and opponents at the same time in order to have a better performance. Table tennis players need to tracking fast balls and react quickly. An exceptional baseball or table tennis player might have a better performance of attentively tracking multiple moving targets than non-athletes. The purpose of the study was to examine this hypothesis.
Methods
All participants were males. 25 elite baseball players and 7 elite table tennis players who were in the highest national leagues, and 19 non-athletes were recruited in this study. The tracking performance for all participants were measured with the typical Multiple Object Tracking (MOT) Task (Pylyshyn & Storm, 1988). Participants were asked to attentively track specific targets wandering around the computer monitor among some distractors for a few seconds, and they reported those targets in the end of trial. The study manipulated the object moving speeds (0.3, 0.6, 0.9, or 1.2 deg/s) in the Experiment 1 and manipulated the number of tracked targets (2 to 5) in the Experiment 2 to measure the capacity limits of attentive tracking.
Results
Baseball players performed significantly higher speed limits (0.74 deg/s) and larger number limits (3.83 targets) than non-athletes (0.57deg/s and 3.57 targets). Table tennis players were significantly better than the non-athletes in tracking speed limits (0.75 deg/s vs 0.57 deg/s). There was not a significant difference between baseball and table tennis players in tracking speed limits and number limits.
Conclusion
This study identified that elite baseball and table tennis players have significantly larger capacity limits of attentively tracking than non-athletes. The findings may be related to the talents and long-term training of athletes in ball sports (Zhang & Watanabe, 2005). The implications of this study may be applied to select young and potential ball athletes.
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Contact
Sheng K Wu, PhD. e-mail: skwu@ntupes.edu.tw

MENTAL SKILLS ASSESSMENT OF JAPANESE HANDBALL REFEREES

MURAKAMI, K.1, UTO, M.2

1: TOKYO UNIVERSITY OF SCIENCE, 2: TOKUYAMA UNIVERSITY

Introduction
Sports umpires, referees, and their assistants are responsible for ensuring that the competitive efforts of athletes take place within the rules of the game, and that match results are obtained fairly. Not only must referees continually endure physical pressure, they should also be willing to psychological endure various stressors. As the best performance cannot be expected from athletes and coaches who

are under a great deal of stress, referees are also unable to demonstrate proper performance in some situations (Reilly & Eregson, 2006). One key factor in referees working to their potential in regard to performance is the use of appropriate mental skills. Therefore, the purpose of this work was to study the mental skills of national-level referees and compare them with those of regional-level referees.
Methods
In collaboration with the Japan Handball Association (JHA), we recruited a sample of 162 JHA-certified referees, divided into 106 Class 1 referees who refereed at the 2015 National League Division 1, and 56 Class 2 referees who refereed at the regional competition. The instrument used was the Mental Skills Inventory for Referees (Murakami, 2016). For refereeing situations, 6 factors were derived from 24 items in the questionnaire and named as follows: emotional control, resolute attitude and look, motivation, confidence, communication, and concentration. In order to evaluate the difference between the two sub-samples, we conducted an unpaired t-test using level of referee license.
Results
The analysis of the results revealed several differences between the mental skills of referees as a function of their license level. The unpaired t-test results revealed that Class 1 referees exhibited significantly superior mental skills than Class 2 referees in all six factors: emotional control, resolute attitude and look, motivation, confidence, communication, and concentration.
Discussion
Results indicated clearly that referees' mental skills differed depending on their certification level. National-level referees had higher scores than regional-level referees on the measurement of emotional control, resolute attitude and look, motivation, confidence, communication, and concentration. The findings of the analysis clearly support previous studies (Weinberg, 2010) in identifying motivation, confidence, communication, and emotional control strategies as important qualities in a good referee. The results provide insight into how we can create more effective mental skills training programmes for this population.
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Contact
kiso@rs.kagu.tus.ac.jp

NEURAL CORRELATES OF SUPERIOR ACTION ANTICIPATION DURING A SPORT-SPECIFIC ATTENTIONAL CUEING TASK IN RACKET SPORT PLAYERS

WANG, C.H., LIN, J.T., CHANG, K.Y., LIN, C.C.
NATIONAL CHENG KUNG UNIVERSITY

Introduction
Although the superior action anticipation in racket sport players has been widely investigated, the neural correlate that supports such athletic superiority is less clear. To further address this issue, the aim of this study was to explore the neural oscillations associated with anticipatory attention and motor preparation during a sport-specific cueing task in racket sport players (i.e. badminton players).
Methods
We compared time-frequency analysis of electroencephalographic (EEG) activity from collegiate badminton players (n = 16, aged 20.36 ± 1.72 years) and a set of matched athletic controls (track-and-field athletes; n = 16, 21.43 ± 1.50 aged ± 1.52 years) when they performed a sport-specific (i.e. badminton) attentional cueing task in which the spatial uncertainty (i.e. high uncertainty: backswing action cues; low uncertainty: low-shot action cues) were manipulated.
Results
Behavioral data showed that, without suffering any increase in error responses, the badminton players responded faster than the athletic controls on the task regardless of spatial uncertainty. The EEG results revealed that badminton players, relative to athletic controls, showed greater decrease in beta power but less increase in theta power during the cue-target interval in the condition involving higher uncertainty (backswing). Such an effect, however, was not seen in the condition involving lower uncertainty (low shot).
Discussion
The results suggest that expertise in sports modulates neural oscillations associated with anticipatory attention and motor preparation when performing a task related to an individual's specific sport domain, which may help elucidate the neural mechanisms underlying superior action anticipation in racket sport players.
Contact
kesawloq@gmail.com

EFFECTS OF THE IMPACT SOUND ON OUTCOME ESTIMATIONS IN GOLF PUTTING

IWAMI, M., TANAKA, H.
TOKYO UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

Introduction
In playing golf, sounds as the club-head impacts against a ball give much information to players. The sound characteristics of club-head impacts, such as pitch, tone, loudness and duration, can cause several psychological effects on golfers (Roberts et al., 2005). Previous research has shown that sounds at the ball impact influences player's "feeling of the shot" in putting. This suggests that auditory feedback information from the impact sounds can contribute to the improvement of putting performance. It can also help players to estimate the distance that a ball would be driven to the hole. This study aimed to clarify whether the absence of impact sound during putting a ball affects not only putting performance, but also outcome estimation accuracy.
Methods
Six expert golfers (golf score handicaps of lower than 3.0) and six novices performed a putting outcome estimation task. The participants were asked to putt a golf ball to a target placed at three different distances (1.2, 2.4 and 3.6 m) and then to estimate the stopped ball position as accurate as possible. They performed the task in two different modes: presence and absence of the impact sound (S and NoS conditions, respectively). We calculated the absolute errors of putts (AE_putt) and estimation (AE_est) to assess the putting performance and outcome estimation accuracy, respectively.
Results

The experts achieved higher putting performance and higher accuracy of the outcome estimation than the novices. For the experts, the AE_putt and AE_est significantly increased at the target distance of 3.6 m under the NoS condition when compared with the S condition. For the novices, there were no significant differences between the two conditions at each of the target distances.
Discussion
Experts can accurately estimate errors of action outcome in baseball batting and soccer place-kicking (Basevitch et al., 2015; Gray et al., 2007). The present study replicated this finding to demonstrate that the expert golfers achieved higher accuracy of outcome estimations than the novices. The absence of impact sound during the putting considerably decreased the performance and outcome estimation accuracy for the experts for the target of 3.6 m. These results suggest that impact sounds provide useful information for skilled-golfers and strongly influence their feeling of the putt, especially for longer target distances.
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THE EFFECT OF ALTITUDE ON FOOTBALL REFEREEING

GAOUA, N., SCOOT, C., MILEVA, K.
LONDON SOUTH BANK UNIVERSITY

Introduction
Human cognitive performance decreases under various stressors among which altitude can be particularly detrimental for sport performance. In these conditions, the referee's responsibility is to consistently apply the laws uniformly and fairly, without waning or adversely influencing the competitiveness of the play. The aim of this study was to investigate the effect of altitude on referees' decision making.
Methods
6 healthy qualified soccer referees (25.8±4.8years, 80.8±10.2kg and 180.9±7m for age, weight and height respectively) participated to the study. Following a familiarization session, referees performed a Go-No-Go cognitive task and a referee specific video decision making task while performing a 90 min treadmill intermittent exercise at sea level (CON) and under hypoxic conditions (3800m, EX). The exercise consisted of two 45min separated by 15min of rest. During these sessions brain (Bo) and muscle oxygenation (Mo) were measured using Near Infrared Spectroscopy (NIRS) and subjective levels of comfort were recorded using a visual analogic scale. Measures were analyzed at 4 time points: before and after the first 45 minutes (T1, T2) and before and after the second 45 minutes (T3, T4).
Results
There was no significant difference between referee's performance at the Go-No-Go task or the referee video decision task between CON and EX at any time. Comfort and Mo were also not significantly different between conditions with all $p>0.05$. Only Bo was significantly different between conditions ($F(1-4) =52.21$, $p<0.05$) with a significant progressive decrease from T1 to T2 ($p=0.037$); T2 to T3 ($p=0.009$) and T3 to T4 ($p=0.019$).
Discussion and Conclusion
Despite a reduction in Bo cognitive performance was not altered throughout the 90 minutes of exercise. Under hypoxic conditions, blood containing O2 could be diverted through an increase of blood flow to deeper structures of the brain in order to protect executive function. In addition the beneficial effect of exercise on cognitive performance might have blunted the detrimental effects of hypoxia.
Further studies are required to fully understand the mechanisms of the combined effect of hypoxia and exercise on cognitive performance.

THE ROLE OF PASSION IN PREDICTING BURNOUT IN VOCATIONAL DANCERS

CASTILLO, I., ÁLVAREZ, O., GARCÍA-MERITA, M., SOLER, M.J. GALILEA, B., BALAGUER, I.
UNIVERSITY OF VALENCIA

Introduction
Grounded in the dualistic model of passion (Vallerand et al., 2003), the aim of the present study was to examine the role of the two types of passion: harmonious and obsessive in predicting burnout over and beyond motivation regulations for dance engagement.
Methods
197 full-time Spanish dance students (33 males and 154 females) with a mean age of 18.65 years (SD = 3.73) participated in the study. Dancers were requested to complete a multi-section questionnaire tapping the targeted variables.
Hierarchical multiple regression analysis were conducted. In order to determine the extent to which passion contributes to changes in burnout over and beyond types of motivation, four types of motivation (intrinsic motivation, identified regulation, introjected regulation and external regulation) were entered first, followed by the two types of passion (harmonious and obsessive).
Results
Results showed that intrinsic motivation ($b = -.18$, $p < .01$) and identified regulation ($b = -.26$, $p < .01$) were negative predictors of burnout, whereas introjected regulation ($b = .25$, $p < .01$) and external regulation ($b = .24$, $p < .01$) positively predicted burnout. Results also showed that harmonious passion ($b = -.29$, $p < .01$) negatively predicted burnout.
Discussion
Overall, findings support that dancers with a harmonious passion will not experience burnout during engagement in the passionate activity.
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PERFORMANCE, MOOD, AND ANXIETY DURING A CLIMB OF MOUNT EVEREST

KARINEN, H., TUOMISTO, M.
UNIVERSITY OF TAMPERE

Introduction
Travelling or climbing in mountainous regions is well known to induce both physiological and psychological disturbances. The hypoxia of high altitude affects the brain, resulting in impairment of neuropsychological function (Hornbein, 2001). Various studies have shown the deleterious effects of high-altitude hypoxia on visual, motor, somatosensory, cognitive and emotional function and in intelligence tests, reaction time, speech comprehension, hand steadiness, visual contrast discrimination and word association tests function (Issa et al., 2016). Because optimal cognitive abilities may be crucial for mountain safety, this study was aimed to evaluate the changes in cognition, mood and anxiety during a nearly three-month Everest expedition.
Methods
A set of physiological, cognitive, and emotional measurements were collected from nine climbers in partly unsupported Mount Everest expedition at various time points during the course of an expedition.
Results
State anxiety was at highest at the beginning of the expedition and was reduced after reaching of the Mount Everest Nepal side base camp (EBC). Most expedition members suffered mild symptoms of acute mountain sickness during the first days in the EBC, but after a couple of recovery days, this did not affect the speed or the numbers of mistakes made in the different cognitive tests. Physical tiredness affects more the number of mistakes than speed.
Discussion
The present study was designed to follow and to describe changes in the mood, anxiety level, and cognitive performance of mountain climbers during a nearly three months' Mount Everest expedition. Altogether, the most important finding in this study was that well-motivated and trained, self-selected individuals who volunteer for a long-duration mission, are capable of maintaining high levels of performance, steady mood state and a good level of vigor during a nearly three months' Mount Everest expedition.
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Contact
heikki.karinen(at)staff.uta.fi

INTEGRABILITY OF RECOVERY TOOLS IN THE PREVENTION OF BACK PAIN – THE BETSI-PROGRAM AT MEDI-COS.AUFSCHALKE

KRUSE, N., HEIDARI, J., ÖZEN, E., KELLMANN, M.
RUHR UNIVERSITY BOCHUM, MEDICOS.AUFSCHALKE, THE UNIVERSITY OF QUEENSLAND

Introduction
Multimodal approaches have been successfully established in rehabilitation programs of back pain within the past decades (Kamper et al., 2015). Psychological aspects such as recovery and stress have been addressed and demonstrated their pivotal role with regard to the health and well-being of individuals (Gerber & Pühse, 2009). However, within primary prevention there is a lack of holistic programmes, which take a biopsychosocial approach into consideration. The aim of the study was to investigate the protective role of two recovery tools on LBP development in employees with alarming health conditions.
Methods
Individuals were examined by the company doctor with regard to precarious health conditions (e.g., back pain, high blood pressure) and were subsequently included into the program. Eligible individuals completed questionnaires assessing sociodemographic data, back pain parameters, and recovery and stress variables before and after the program (T0 and T1).Within the framework of a three-month training phase, participants receive various intervention tools. In addition to a weekly health-oriented physical training, intervention tools on the topics recovery and stress were implemented. These tools provided information about recovery and stress as well as applicable tools (e.g., recovery experience diary, breathing relaxation). Additionally, an inactive control group has been gathered completing the questionnaires at the same measurement points.
Results
Thus far, no results can be presented, as a part of the participants has not finished the program. At this time, the sample consists of 131 participants who have accomplished the first measurement point and in parts the second measurement point. Until the end of September 2017, all participants will have completed the program and can be included into the analysis of the results. From a statistical perspective, we intend to use a multiple regression analysis to obtain results.
Discussion
The basic idea of the study as well as potential problems regarding future programs should be discussed. In addition, approaches to the procedure at the data analysis can be debated. As a primary result, we expect that a dysfunctional recovery and stress balance may serve as a potential risk factor for back pain, which can be effectively reduced by the intervention tools of our program.
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Contact
nele.kruse@rub.de

THE CORRELATION BETWEEN MINDFULNESS AND THE RECOVERY-STRESS STATE AFTER PHYSICAL PERFORMANCE AND FOLLOWING RECOVERY

HOF ZUM BERGE, A.1, FÜHRER, A.1, PELKA, M.1, KELLMANN, M.1,2

1: RUHR UNIVERSITY BOCHUM, 2: UNIVERSITY OF QUEENSLAND

Introduction

Optimal physical success can only be performed if a balance of stress and recovery is guaranteed (Rowbottom et al., 1998). Present scientific recovery strategies mostly aim to change the state of arousal based on the concept of cognitive behavioral therapy (Heidenreich et al., 2007). Different to control-based approaches trying to replace negative emotions by positive ones, mindfulness-based techniques underline recognition, observation and acceptance of these feelings (Jekauc & Kittler, 2015). Current studies mostly focus on the influence of mindfulness on the performance capacity. Studies researching the correlation between mindfulness and the recovery-stress state of athletes have not been published yet.

Methods

Forty-one German students (age 22.24 ± 3.6 years; sports participation 6.54 ± 2.93 h/week) underwent a graded cycle ergometer exercise following a 25-minute recovery phase in a horizontal position in a darkened room. Subjective perception of recovery and stress was measured before and after recovery with the Short Recovery and Stress Scale (SRSS; Kellmann et al., 2016), consisting of 4 recovery and 4 stress items. Mindfulness was assessed with the short version of the Kentucky Inventory of Mindfulness Skills (KIMS-Short; Höfling et al., 2011), which can be divided into 4 subscales. Correlations between SRSS and KIMS-Short ratings were analyzed following the physical task and following relaxation.

Results

SRSS-items and KIMS-Short subscales did not correlate significantly after physical performance. After recovery, KIMS-Short subscale Describing and Labelling Phenomena correlated with SRSS-items Physical Performance Capability ($r_s = .32$, $p < .05$), Emotional Balance ($r_s = .48$, $p < .01$), Muscular Stress ($r_s = -.41$, $p < .01$) and Overall Stress ($r_s = -.36$, $p < .05$). KIMS-Short subscale Acting with Awareness correlated with Emotional Balance ($r_s = .40$, $p < .05$), Lack of Activation ($r_s = -.39$, $p < .05$) and Negative Emotional State ($r_s = -.38$, $p < .05$).

Discussion

Mindfulness does not seem to correlate with the perception of recovery and stress directly after physical performance, but with its perception after recovery phase. Future studies should examine whether mindfulness-based training can optimize the recovery and stress skills on a subjective and objective level. An extension of the present study to high-level competition sports may also be considered.

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Contact

annika.hofzumberge-b9a@rub.de

Rehabilitation and Physiotherapy

RELATIONSHIP BETWEEN FUNCTIONAL MOVEMENT SCREEN RESULTS AND HISTORY OF PHYSICAL PROBLEMS IN HIGH SCHOOL FOOTBALL PLAYERS AND RUNNERS IN JAPAN

NAKAGAWA, K.1,2,3, ENDO, Y.3, INOMATA, N.3, OKUI, Y.3, SASAKI, S.3, OBOKATA, Y.3, OKAWARA, K.3, TAKEI, K.3

1: TAKASAKI UNIVERSITY OF HEALTH AND WELFARE (TAKASAKI, JAPAN), 2: FRESENIUS UNIVERSITY OF APPLIED SCIENCES (MÜNCHEN, GERMANY), 3: PS. LAB (JAPAN)

Introduction

Maintenance of posture and movement as well as muscle strength, flexibility and range of motion of the joints is important to avoid sports injuries. The Functional Measurement ScreenTM (FMS) is gradually being used for the evaluation of fundamental movement in sports (Cook et al., 2014). The purpose of this study was to examine the relationship between FMS results and history of injuries from various viewpoints in high school football players and runners.

Methods

The subjects included 164 high school football players (F; 16.2 ± 0.9-year-old) and 49 track and field runners (R; 16.2 ± 0.9-year-old). Injury and disability histories in the past year based on the criteria of the International Olympic Committee were examined, and each item of FMS was evaluated. In each competition, the subjects were compared and examined according to the characteristics of the injuries (frequency, type and cause) and were also compared to each other. In the F group, the subjects were divided according to the existence of a different score between the left and right side or a score of 1 point; FMS results in both the group were compared to each other.

Results

In the F group, those with three or more injuries in the past year had a significantly lower total FMS score (13.9 ± 2.6) than those without a history of injury (14.7 ± 2.1), whereas in the R group, opposite results were seen (17.3 ± 2.1 and 16.4 ± 1.5). In addition, among 103 of the F group who had a history of injury to lower limbs, only the 'Active Straight Leg Raise' scores were asymmetric. Furthermore, those who had a hip joint problem had a tendency of scoring 1 in the 'Deep Squat'.

Discussion

Among runners who had frequently physical disorders caused by overuse, only FMS might be insufficient for injury prevention. Furthermore, among football players who have a difference in the flexibility between the left and right limbs and no difference in the muscular strength or stability, an excessive burden in the movement required for playing football supposedly caused some lower limb injuries. In addition, the usefulness of the 'Deep Squat' can be considered as a screening evaluation for hip joint diseases in football players. The versatility of FMS as an evaluation targeting a group can also be expected in the future, but a useful combination including competitive characteristics and longitudinal examination would be necessary for further verification of diversity.

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Contact
nakagawa-ka@takasaki-u.ac.jp

ASSOCIATION BETWEEN LOCOMOTIVE SYNDROME AND PHYSICAL FUNCTION IN COMMUNITY-DWELLING OLDER ADULTS: A LONGITUDINAL STUDY

IKEZOE, T., ISONO, R., ICHIHASHI, N., TABARA, Y., NAKAYAMA, T., MATSUDA, F., TSUBOYAMA, T.
GRADUATE SCHOOL OF MEDICINE, KYOTO UNIVERSITY

Introduction
The term 'locomotive syndrome' is defined as a condition requiring nursing care, or being at risk of developing such a condition, because of a decline in mobility resulting from a disorder of the locomotive system such as the bones, joints, and muscles (Nakamura, 2008). No longitudinal study has investigated the association between the locomotive syndrome and multidimensional factors involved in physical function in elderly people. Therefore, we investigated this relationship in community-dwelling older adults.
Methods
The subjects comprised 389 community-dwelling older adults (127 men, 262 women, aged 67.0±4.9 years).
Physical function was assessed at baseline, which included handgrip strength, maximal isometric strength of hip flexion, hip extension, hip abduction, knee extension, and toe flexion (an index of muscle strength), chair–stand test (an index for leg muscle power), one-legged stance test (an index for static balance function), timed up & go (an index for dynamic balance function), and 30-s stair test (an index for leg muscle endurance). The locomotive syndrome was assessed using a 25-question Geriatric Locomotive Function Scale (GLFS-25) before and after a 12-month period. The GLFS-25 consists of 25 items with a score of 0-4 for each item, with higher scores indicating worse conditions. The subjects were classified into two groups (decline group or non-decline group) based on changes in the GLFS-25 score compared with baseline. Subjects with an increased GLFS-25 score ≥ 2 were classified as progression to a decline in mobility, that is, higher locomotive syndrome risk, and were categorized as the decline group. Logistic regression analyses with the dependent variable as the locomotive syndrome groups and the independent variables as age and physical function were performed to determine the association between the locomotive syndrome and physical function.
Results
Of 389 subjects, 169 (43.3%) were included in the decline group, which was defined as an increase in the GLFS-25 score ≥ 2 over a period of 12 months. In the logistic regression analysis for the locomotive syndrome, only hip flexor strength was revealed as a significant and independent determinant.
Discussion
We examined the relationship between the locomotive syndrome and physical function among community-dwelling older adults in a longitudinal study that showed that hip flexor muscle strength alone was a significant and independent determinant of the locomotive syndrome. These results suggest that among physical functions, hip flexor strength influences the decline in mobility resulting from a disorder of the locomotive system in elderly people.
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Contact
ikezoe.tome.4u@kyoto-u.ac.jp

THE EFFECT OF CARBONATED ICE BATH ON MUSCLE FATIGUE RECOVERY

KUDO, H., TAKAKUSAKI, K.
MEJIRO UNIVERSITY

Introduction
It is known that ice bath suppresses edema after exercise and excessive local metabolism and has an effect on recovery from fatigue.
On the other hand, the carbon dioxide bath is one of the beneficial methods for improvement of blood flow and recovery from fatigue, via increasing of tissue partial pressure of oxygen due to transcutaneous absorption of carbon dioxide. If a greater effective recovery effect can be obtained by using carbonated bath with ice bath, its significance is considered to be great. The purpose of this study was to confirm the effect of the carbonated ice bath by comparing the degree of muscle fatigue recovery with ice bath and the carbonated ice bath, against exercise muscle fatigue.
Methods
This study comprised 18 healthy male volunteers (6 ice bath, 6cabonated ice bath, and 6 control). All volunteers performed three sets of 30 times knee extension exercise using an isokinetic dynamometer. After exercise, each recovery program (ice bath: 15 ℃, carbonated ice bath: 15 ℃, carbonic acid concentration: 250ppm, control: rest) was carried out for 15 minutes. Further 24 hours later, another set of 30 times isokinetic knee extension exercise was performed again, and muscle strength of Quadriceps muscle was measured. The peak torque and muscle endurance measured after 24 hours was compared with the peak torque and muscle endurance of the first set on the first day exercise. The difference between the average value of the 2nd to 10th times of the first set of knee extension movements and the average value of the 21st to 30th times was defined as the torque reduction amount (Nm/kg), which was used as an index of the muscle endurance.
Results
The amount of torque reduction (muscle fatigue) in the ice bath group (45.0 ± 18.8) and the carbonated ice bath group (40.5 ± 13.2) was significantly lower than that in the control group (58.3 ± 6.8). Although there was no statistically significant difference, the torque reduction amount of the carbonated ice bath group was lower than that of the ice bath group. There was no significant difference between the 3 groups in the peak torque value.
Discussion
From the results of this study, it was suggested that the recovery effect on muscle fatigue was observed in both the ice bath and the carbonated ice bath, and in particular, the carbonated ice bath may show more effective recovery effect. However, the effect of carbonic acid has concentration dependence, and it seems necessary to study the effect by the carbonate ice bath at high concentration in the future.
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RELIABILITY OF LOWER LIMB ELECTROMYOGRAPHY AND BIOMECHANICS OF HEALTHY YOUNG PARTICIPANTS DURING RAMP ANKLE ASCENDING AND DESCENDING

WANG, P.Y., WANG, H.K., SHIH, K.S., MA, H.L., SU, S.H.
NATIONAL TAIWAN UNIVERSITY

Introduction
The ability to climb stairs, which involves ankle plantar (ascending) and dorsal flexion (descending), is an important functional outcome after injury. Ground reaction force and electromyography of the leg muscles and Achilles tendon vibration frequency during one-legged weight bearing ankle motions have shown differences between legs with and without Achilles tendinopathy.1,2 However, few studies have been performed to test the reliability of those measurements during ankle motions. Therefore, the aim of this study was to estimate the reliability of those measurements in young healthy subjects.
Methods
Young healthy subjects (<35 years old) without any positive sign of Achilles tendinopathy were recruited. The same researcher performed first and second measurements, separated by a week. Each subject was asked to stand on a plywood box placed on a Kistler force plate (9260AA, Switzerland). While standing on one leg with their forefoot on the edge of the box, each subject was asked to lift and then lower the heel to the maximal position every 2 seconds. Kinematic data were acquired by a 2D motion analysis system (MyoVideo, Noraxon, USA). Myoelectrical activities and soft tissue vibration frequencies were respectively measured by EMG-recording electrodes (TELEMYO DST, Noraxon, USA) and an accelerometer (DST, Noraxon, USA). Each task was composed of three cycles of ankle plantar and dorsiflexion. The intraclass correlation coefficient was used to estimate the reliability of the measurements. Data was analysed using SPSS 19.0 software with the alpha level set at 0.05 (SPSS Inc., Chicago, IL).
Results
Eighteen subjects with an average age of 23.1 years old were recruited. The intraclass correlation coefficients in the myoelectrical recordings of the ascending and descending phases and in the biomechanical recordings ranged from 0.550–0.913, 0.573–0.865 and 0.028–0.473, respectively.
Discussions
Our results show that electromyographic activities in the soleus muscle are reliable in both time and frequency domain analyses. It is suggested that future studies be conducted using the electromyography of the soleus and tibialis anterior muscles during ankle motions to investigate muscle activation or antagonist coactivation in patients with Achilles tendinopathy.
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PARASPINAL MYOFASCIAL TISSUE CHARACTERISTICS ARE LUMBAR LEVEL DEPENDENT

KURZ, E., SCHENK, P., ANDERS, C.
CLINIC FOR TRAUMA, HAND AND RECONSTRUCTIVE SURGERY

Introduction
Besides different active intervention regimens, chronic musculoskeletal pain is often treated by applying a variety of manual interventions using different modalities to influence myofascial tissues. The effects of these interventions are predominantly reported on a subjective basis either by the patient or therapist. Thus, to provide a step towards objectifying treatment effects, this investigation aimed at examining spatially resolved tissue characteristics of the paraspinal lumbar region.
Methods
Tissue characteristics of 18 recreationally active women (age: 37±8 years, body mass index: 25±3 kg/m²) without low back pain were examined using a device to detect biomechanical tissue properties (Myoton AS, Tallinn, Estonia). Measurement points were marked on the skin of subjects' left side, 2.25 cm from midline at each lumbar spinal level. For the measurements, participants were lying prone with their arms in a comfortable position. To detect myofascial properties, subsequently 12 mechanical taps (time: 15 ms, interval: 0.8 s) were applied by the MyotonPro at the marked locations (Schneider et al. 2015). The averaged waveform of the recorded damped tissue responses were analyzed separately for every lumbar level. The following two tissue characteristics were analyzed: oscillation frequency (OF in Hz, tone or tension) and dynamic stiffness (DS in N/m, resistance to a contraction). Effects of lumbar levels on both outcome variables were analyzed by a repeated measures ANOVA. This was followed by pairwise comparisons. Effect sizes were calculated as partial eta squared (ηp^2).
Results
Data variability for the measured points was low for both variables (coefficient of variation range, OF: 1.1-2.5, DS: 2.0-2.7), suggesting a low data dispersion. The repeated measures ANOVAs revealed large systematic effects of lumbar levels for both variables (OF: $F(4, 68) = 11.9$, $P = 0.001$, $\eta p^2 = 0.41$; DS: $F(4, 68) = 23.7$, $P < 0.001$, $\eta p^2 = 0.58$). Subsequent pairwise comparisons showed significant differences ($P < 0.05$) between all lumbar levels (except OF between L2 and L3) with decreasing values in cranio-caudal direction (OF: 16.4-13.7 Hz, DS: 352-255 N/m).
Discussion
Findings from the current study lead us to suppose that in vivo passive tissue characteristics of the lumbar region are level dependent. The tissue directly surrounding the lumbar spine appears to be heterogeneously organized in female healthy subjects. This obvious characteristic needs to be proven in men and is worthy of attention in patients with lower back pain – before and after specific interventions.
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Contact
eduard.kurz@med.uni-jena.de

DEVELOPMENT OF A NEW METHOD FOR COUNTING STEPS TAKEN WHILE WALKING USING A THREE-AXIS ACCELEROMETER IN PEOPLE WITH STROKE

SHIMIZU, S., YAMADA, R., ICHINOSAWA, Y., ARISAKA, N., MAMORITA, N., TSURUTA, H., MATSUNAGA, A.
KITASATO UNIVERSITY

Introduction
Information on the amount of physical activity undertaken during daily living is important for implementing disease management for physically disabled people. However, the number of steps taken in post-stroke individuals is difficult to monitor and measure exactly using a conventional pedometer, because they often exhibit gait abnormality due to paralysis in their lower extremities. This study aimed to develop a method of counting steps while walking using a three-axis accelerometer in post-stroke patients by clarifying the effects of walking speed and severity of paralysis on its step count accuracy.
Methods
We recruited sixty-one stroke patients (38 men; mean age, 67 ± 16 years; mean comfortable walking speed, 34.3 ± 20.0 m/min). Any patients capable of walking without aid or support were eligible for this study. An iPod Touch with a three-axis accelerometer was attached to the back of the patient's lower thigh on both sides (paretic and non-paretic). Three (vertical, forward, and backward) axis accelerations, and the composite acceleration, which was determined by calculating the square root of the sum of squares of the magnitudes of the three axis accelerations, were converted to a power spectrum using a Fast Fourier transform (FFT) method. Estimated steps during walking were derived from the peak frequency of the spectrum. We also calculated the error rate for the estimated steps compared with the actual steps that our staff counted visually during walking. All patients were divided into two groups (fast and slow speed groups) based on comfortable walking speed (> 30 m/min, or ≤ 30 m/min), and also into two groups (mild vs. severe paralysis) based on the Brunnstrom Recovery Stage test. Differences in error rate between groups were examined by two-way ANOVA and the Bonferroni test. This study was approved by the Kitasato University Ethics Committee.
Results
The error rate derived from the composite acceleration of the non-paretic side was significantly smaller than that of the other three axis accelerations in all groups ($p < 0.05$ for all). No significant differences in error rate based on the composite acceleration of the non-paretic side were noted between the fast and slow speed groups, or between the mild and severe paralysis groups. No consistent trends were observed in the error rates derived by the three axis and composite accelerations on the paretic side for any of the patients.
Discussion
Our step-counting method while walking using the FFT method of the composite acceleration may be more accurate without the influence of walking speed variation and severity of paralysis in post-stroke patients.

CORRELATION BETWEEN THE HAMSTRINGS MUSCLE ACTIVITIES AND THE KNEE ROTATION ANGLE DURING ISOMETRIC KNEE FLEXION

AOKI, N., TANAKA, V., KATAYOSE, M.
SAPPORO MEDICAL UNIVERSITY

Introduction
The hamstring muscles are composed of four muscles: the semitendinosus muscle (ST), the semimembranosus muscle (SM), and the short and long head of the biceps femoris muscle (BF). Its function is not only hip extension and knee flexion, but also tibia rotation. Physical therapists may experience that the rotation of the tibia during knee flexion varies from each subject. If the muscle activity of the hamstrings can be estimated from the rotation of the tibia, it becomes basic information for constructing the hamstrings evaluation method. The purpose of this study was to elucidate the correlation between knee muscle activity and knee rotation angle during isometric knee flexion.
Methods
Fifteen healthy young individuals participated in this study. The research purpose and measurement details were sufficiently explained to subjects in writing, in advance, in accordance with the Declaration of Helsinki. Subjects performed maximum voluntary contraction (MVC) of the knee flexors at 90° knee flexion with the prone position. Surface electromyography (EMG) and knee rotation angle were recorded during MVC, and root mean square EMG (RMS) were calculated from the obtained EMG data. Muscles examined were the ST, SM and BF. The correlation coefficient was examined for knee joint rotation angle and RMS value of each muscle.
Results
The angle of the knee external rotation was significantly and negatively correlated with the RMS value of the semitendinosus muscle.
Discussion
These results indicate that ST contributes to the generation of knee internal rotation during knee flexion. This suggested that the function of semitendinosus muscle can be estimated by evaluating knee rotation angle during knee flexion.

Sociology

THE EMPIRICAL ANALYSIS ON THE INFLUENCE FACTORS OF COMPETITION IN TRADITIONAL OLYMPIC COUNTRIES

WEIDONG, S.
NANJING UNIVERSITY OF AERONAUTICS AND ASTRONAUTICS

Introduction
Chinese sports face a new transformation after the 2008 Beijing Olympic Games, the Olympic Strategy gradually out of the mainstream and come into the big era in sports, to choose more social effect sports of the sports for all. However, under the new situation, how to implement the new Olympic Strategy more effectively and to improve the overall level of competitive sports became an important issue.
Methods
Put the traditional Olympic country (TOC) defined as the country that win the medals over 12 times in the modern summer Olympic Games among 40 countries, whose Olympic Games' road maybe a teacher to guide China or other countries under new situation. 1) In order to discuss and select the influence factors of competition in TOC, using factor analysis to classify the present influence factors, and extract the main factors as the independent variable of competition ability; 2) using multiple regression equation to parse the extractive main factor and political background variables that how do they specifically affect competition ability.

Results
Results through the system study of TOC : the factors affect Olympic competition ability are medals of three big ball、fundamental items、times of hosting Olympic Games、GDP, and they are constitute the national sports ability factor, and one party or the socialist regime is more efficient in the political background. However, the national sports ability factor has greater influence than the latter.
Discussion
Three big ball and the Chinese Olympic system are parallel to each other, the big era in sports of three big ball、fundamental items and powerful Olympic country are integrated. Actually, these results certificate the coupling of school PE and competitive sports under chinese new situation, and put more clear to several contents and developing direction of Olympic's general plan.
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Contact
E-mail: 2512343145@qq.com

Sport Management and law

DEVELOPING A STRATEGIC PLAN FOR IRAN'S WRESTLING FEDERATION USING SWOT ANALYSIS

RIAHI, E., SOURIAN, H.
ISLAMIC AZAD UNIVERSITY

Introduction
Sport is a highly competitive area that requires this type of environmental planning and long-term objectives with respect to the internal and outside limitations of any organization. The purpose of this study was to identify the strengths, weakness, opportunities, and threats of the Wrestling Federation of Iran and help with finding the best strategies for developing Wrestling across the country.
Methods
The research methodology is descriptive survey and in terms of the goal, it is applied. The data has been collected by studying documents and papers, study the literature review and gathering the views of experts in this field both in academic and executive ranks. In addition, the authors developed a questionnaire, the validity of which was confirmed by the experts and the reliability was approved via Cronbach test (α= 0.81). The data has been collected by studying documents and papers, study the literature review and gathering the views of experts in this field both in academic and executive ranks. The questionnaire consists of 6 options for the strong point, 7 options for weak points, 5 for opportunities and 5 for threats. The collected data was analyzed by using SPSS software and descriptive statistics indexes (frequency, percentage of frequency, mean, and criteria bias) and the inferential statistics of Freedman test was used to classify each one of the internal and external factors. The statistical society of the research consisted of experts of sports for all department of the Sports, experts and managers at school .
Results
The results of the research showed that basic sport is in WO status in strategic position terms and it should use conservative strategies; and, developing strategic plan, selecting suitable strategies such as Establishing a scouting system and focusing on Wrestling in adolescents, youths, and women; establishing a marketing system and organizing financial support; with respect to the cultural, social and climatic requirements should seek existing opportunities in the outside environment to recover from its internal weak points.

EVALUATION FOR SERVICE QUALITY PROVIDED BY A LOCAL SPORTS CLUB

BIZEN, Y., MURAKAMI, K.
KOKUGAKUIN UNIVERSITY

Introduction
In recent year, local sports clubs have been taking important roles to develop sports in Japan. Each club offers several sports programs, e.g. football, gymnastics and track & field, to its local community. However, it is reported that many clubs have been struggling with their business management. Especially, many clubs are facing to financial problems due to acquiring or maintaining their members (Mext,2016). It is very important for local sports clubs to understand the demands that their members have for their stable management.
Kaneko et al.,(2009) mentioned 13 items, e.g. "Acquiring sports skills", "Improving physical fitness" and "Enhancing coordination with other people", as expectations that parents have for their children's sports activities. Also, many researchers revealed that customer satisfactions might be increased if "Service Quality" that consists of programs, staff and facilities is improved in sports industry (Parasuraman et al.,1985; Yamazaki, 1994; Shoho et al.,2013). The purpose of this study was to examine the expectations that parents have for their children's sports activities, and how they are evaluating service quality that the local sports club provides.
Method
A questionnaire survey was conducted to parents whose children participate in sports activities at a local sports club between two months in 2015. Participants answered the questions about "expectations for children's sports activities" and "service quality" in this study.
Results
During three weeks, a total of 327 questionnaires were distributed and 219 were collected in this study. In terms of "expectations for children's sports activities", many parents showed that educational effects, e.g. "learning to follow rules" and "Enhancing coordination with other people", are more important than sport-related aspects. In addition, as we used ANOVA to examine the mean difference among groups on sport orientation, there is a relationship between sport orientation and expectations for children's sports activities. In terms of service quality, the club received high evaluation marks on human services while the participants gave relatively low evaluations for the services related to facilities which are parking, the cleanliness of facilities and adequacy of space in this study.
Discussion
Most members of the local sports club might understand and be satisfied with management efforts which the club is devoting because the club received high scores on human services in terms of service quality. On the other hand, it was found that the club needs to improve the quality of their facilities to increase the customer satisfaction of their members. However, realistically, it is difficult for a club to do large scale renovations for its facilities. In fact, not only the club, most local sports clubs are using public sports facilities owned by local

governments in Japan. Therefore, it is suggested that local sports clubs should closely coordinate with local governments to improve their service quality.

Sport Statistics and Analyses

DIFFERENCES IN SELF-EVALUATION OF BODY SHAPE BASED ON WHETHER DIETING OR NOT, GENDER, AND BETWEEN JAPANESE STUDENTS AND ASIAN INTERNATIONAL STUDENTS

AOYAGI, O.1, SAKAGUCHI, H.2, ANNOURA, T.2, CHOI, T.3, HAN, N.3, HONG, T.3, NAM, Y.4, KOO, K.5

1: FU (JAPAN), 2: NKU (JAPAN), 3: JNU (KOREA), 4: DWU (KOREA), 5: CNU (KOREA)

Introduction
Self-evaluation of one's own body shape can be thought as one of the factors driving people to dieting. It can be easily inferred that there is a difference between Japanese students and international students due to differences in perceptions of one's body and health, as well as between males and females. Thus, this study clarifies the characteristics of self-evaluation of body shape and investigates the differences, whether dieting or not, male or female, and Japanese or not.
Methods
A questionnaire survey concerning self-evaluation of one's body shape, developed by Tagawa et al. (2000) and consisting of 25 items were administered to 991 Japanese N-university students including Asian international students (371 male international students, 363 male Japanese students, 170 female international students, and 87 female Japanese students) in January 2015. Answers were obtained based on a 5-point scale from "strongly feel (5 points)" to "do not feel at all (1 point)." At the same time, they were asked about their dieting experience. Factor analysis with the maximum likelihood method, Promax rotation and Thurstone's method, was applied to the self-evaluation data to obtain factorial structure and factor scores. Then, Qualification Theory Type One (QTTO) using the scores of each factor as a dependent variables and dieting experience, gender, and nationality as independent variables was conducted to investigate the relationship between the two.
Results
As a result of factor analysis, three factors such as the "Negative self-evaluation for one's body shape as perceived it by oneself" factor (F1), the "Negative self-evaluation of one's body shape as perceived by others" factor (F2) and the "Positive self-evaluation for one's body shape" factor (F3) were extracted and interpreted. Next, the results of QTTO and deviation analysis being applied to these three factors were that the multiple correlations of all three factors were significant at the level of 0.1%. However, high correlations to dieting or not, gender, and nationality were found in negative self-evaluation of one's body shape (F1 and F2), but not in positive one (F3).
Discussion
Ranges of category weights and partial correlation coefficients in negative self-evaluation factors told us that gender differences contributed more than nationality to the factors, but that the element of dieting or not contributed more than gender differences. That is to say, it can be said that negative self-evaluation for one's body shape drives people to diet rather than body image based on gender or nation-inherent culture and customs.
Contact
aoyagi@cis.fukuoka-u.ac.jp

CRITERION-REFERENCED EVALUATION OF TEAM BATTING SKILL FROM GAME DATA OF PROFESSIONAL BASEBALL

YASUHIRO, T.

UNIVERSITY OF TSUKUBA GRADUATE SCHOOL

Introduction
Sabermetrics [1] has been utilizing tactical analysis and player evaluation of baseball, even more based on high quality research facing the essential part of baseball [2] [3]. Although Sabermetrics was judged comprehensively from multivariate data, criterion-referenced measurements have never been constructed. Criterion-referenced evaluation for team batting skill (TBS) was valuable. The purpose of this study was to construct TBS measurement items which not included in Sabermetrics, from game data of professional baseball.
Methods
Scaling procedure was consisted of nine steps which were 1) analyzing TBS qualitatively by casual-Effect analysis with Delphi method, 2) processing a dataset from game data of professional baseball in Japan, 3) applying exploratory factor analysis, 4) analyzing construct validity of TBS by using structural equation modeling (SEM), 5) analyzing the success criteria (SC) of team batting performance items by using decision tree analysis (DTA), 6) processing a binary dataset using the SC, 7) analyzing test and item characteristics of TBS items by using item response theory (IRT) analysis, 8) calculation of TBS score for the criterion-referenced measurement of TBS, 9) analyzing validity of TBS score.
Results
TBS items with content validity were constructed by analyzing qualitatively by casual-effect analysis with Delphi method. Construct validity of TBS items were confirmed by analyzing the factor structures of TBS consisted from three factors of on-base, advance, and score batting skills by SEM. SC was analyzed the first branch value of each independent variable of TBS items by using DTA. Winning contribution rate (WCR) was calculated from the achievement rate of the dependent variable of winning rate. Test and item characteristics of TBS were confirmed by IRT analysis. TBS score was calculated from the batting technical skill based on item difficulty and WCR. The criterion-referenced evaluation of 29 TBS items was constructed, and those were not Sabermetrics index. By using logistic and poison regression analyses, TBS score was correlated to the game performance and the runs.
Discussion
The criterion-referenced evaluation scale of TBS was constructed of 6 items for on-base batting skill, 5 items for advance batting skill, and 18 items for scoring batting skill.
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SCALING OF CRITERION-REFERENCED EVALUATION OF SOCCER DEFENSIVE TACTICAL SKILL BY USING TRACKING DATA

MATSUOKA, H., TAHARA, Y., YAMAMORI, A., NAOMOTO, H., ANDO, K., MISHIO, S., NISHIJIMA, T.
UNIVERSITY OF TSUKUBA

Introduction
Use of tracking data of soccer game to analyse soccer performance has been increased. It is, however, necessary to analyse soccer tactical performance. The purpose of study was to construct a scale of criterion-referenced evaluation of soccer defensive tactical skill (SDTS) from tracking data of soccer game by applying decision tree analysis and Item Response Theory (IRT).
Method
An official game of J-league in 2016 season in Japan was analysed to develop SDTS. All defensive moments corresponding to opponent attacking action such as passing during the game was analysed. Total defensive moments were 2,206 defensive moments. Scaling procedure was consisted of nine steps which were 1) analysing qualitative structure of SDTS by causal-effect analysis with Delphi method, 2) processing a dataset, 3) analysing factor structure of SDTS applying exploratory factor analysis, 4) analysing construct validity of SDTS by structural equation modelling (SEM), 5) analysing success criteria of defensive plays by using decision tree analysis, 6) converting to a binary dataset, 7) analysing test and item characteristics of the scale of SDTS by using IRT with two-parameter-logistic model (2PLM), 8) calculation of SDTS score, which showed the criterion-referenced measurement of defensive plays, 9) analysing validity of SDTS score. SDTS score between successful and unsuccessful defence plays were compared by Man-Whitney U test. The qualitative causal and effect structure of SDTS were consisted of the first defence and block defence skills. Twenty-nine items were created to measure SDTS from the tracking data. The items of SDTS had construct validity to the factor structure. The success criterion of the items of SDTS was revealed by decision tree analysis. Test and item characteristics which were consisted of 24 items were analysed by IRT. Then, a success criterion of the item of SDTS and difficulty of the item of SDTS was used to calculate SDTS score. SDTS score was compared between successful and unsuccessful defence plays.
Results
Score of successful SDTS (4.8, IQR= 1.5) was significantly higher ($Z = -12.16$ $P<0.000$) than score of unsuccessful SDTS (3.9, IQR= 1.9).
Discussion
It was possible to consist SDTS qualitatively by applying Delphi method and causal-effect analysis. This procedure allowed to reveal causal structure of SDTS which was not enough to define from previous scientific research (Suzuki & Nishijima., 2005). Also, valid SDTS score was calculated by combinational use of statistical analysis.
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BLOOD LACTATE TESTING AFTER 6 MIN 100% VO2 MAX SPEED

CHUANG, W.A.1, CIOU, Y.S.1, HSU, X.Y.1, CHIU, S.F.1
TAIWAN TEXTILE RESEARCH INSTITUTE I

Introduction
Compression garment has one of the important functions was enhance of blood lactate clearance. It would be affected by exercise time and intensity. There have a lot of different way to test. Therefore, the aim of this study was to find out a blood lactate test approach for compression garment.
Methods
Six male runners in this study completed 5 testing separated by at least 7 day. First, the Bruce protocol testing was performed to check VO2 max. Then, they would random to wear control (C) and compression garments (CG) running for 2 times each. The blood lactate test method used a constant load treadmill running at peak VO2 max speed 6 mins (Eliakim, Bodner, Meckel, Nemet, & Eliakim, 2013). The blood sample was drawn before warm up and after exercise immediately, 1, 3, 5, 10, 15, 30, 60 minutes of the recovery period immediately. Blood lactate clearance was calculated by the formula as follows: (Peak blood lactate value after exercise-Blood lactate value before exercise) / (Peak blood lactate value after exercise-recovery blood lactate value at 60 minutes of the recovery period). Pearson correlation coefficient was used to determine the test-retest reliability. The paired T-test and nonparametric statistics was compared difference between C and CG groups. The level of significance was set as $p \leqq 0.05$.
Results
The 2 test of C and CG groups, the result of intergroup relation is Pearson correlation coefficient value of 0.949 and 0.994. The p value of pair T test and nonparametric statistics is 0.216 and 0.249 compared with blood lactate clearance of C2 and CG2 testing results. (94 ± 7.7% and 100 ± 5.8%)
Discussion
The results of this study indicate that test-retest reliability reach high level in both groups. But there was no significant difference in post-60min blood lactate clearance between C and CG group. In the previous study almost used an incremental exercise testing methods that subjects ran to exhaust (Faude, Kindermann, & Meyer, 2009; Machado, Kravchychyn, Peserico, da Silva, & Mezzaroba, 2013). But the accuracy and time of testing are both important to a department of testing. So this study used a protocol that constant load treadmill running at peak VO2 max speed 6 mins spent fewer time than previous study. Although the blood lactate clearance was no significant difference, CG group could see blood lactate clearance enhanced by approximately 6.38%.
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Contact
wachuang.r090@ttri.org.tw

STATISTICAL PERFORMANCE ANALYSIS OF PB SWIM TIMES FROM THE 2016 RIO OLYMPICS.

PETERSEN, C., BACON, C.
UNIVERSITY OF CANTERBURY

Introduction
As the pinnacle of elite swimmers' careers where swimmers strive to produce personal best (PB) times the Olympics provide a unique benchmark by which to assess successfulness of preparation regimes. Relative gain in swimming performance is easily calculated and this indicator of performance increment or decrement is regarded as the ultimate estimation of peaking. The aim of this research was to quantify the likelihood of producing an Olympic PB and the expected magnitude of improvement.
Methods
Using the individual pool swimming events of the 2016 Rio de Janeiro Olympic competition we analysed relative swim performance gain (RSPG%) or decrement from PB time using data from 793 swimmers (1075 event entries) competing in the 13 male and female individual events. Every athlete sampled had their pre-Olympic Games official PB time and associated date that this was achieved recorded. These results were obtained from either the Federation Internationale de Natation Amateur (FINA) or from the swimmers national governing swimming body using Olympic standard qualification recognized events (performed in 50m pools). Analysis of variance (ANOVA) and hierarchical linear regression were performed to estimate the effect of gender, stroke-type, swimming distance, age, and days since PB, on PB times.
Results
We found 31.5% (339) of swimmers registered a PB time during the Rio Olympics. Mean PB improvement was 1.6 ± 3.2% faster, with PB times coming 437 ± 473 days following a previous PB. Younger swimmers (≥ 19 years) were more than twice as likely to produce a PB as swimmers older than 25 years. Gold medallists had ~81% PB success rate, while silver and bronze medallists produced a PB relatively less often (62%, 54% respectively). Swimmers failing to set a PB swam 1.5 ± 1.4% slower than their actual PB. The 50m Freestyle was associated with the greatest RSPG% improvement (Males 0.3%, females 1.5% faster) which was the only exception to the trend for an increased likelihood of setting a PB with races over an increased distance. The United States (50%), Japan (50%) and New Zealand (47%) had the highest percentage of swimmers producing a PB time. From the ANOVA four of the variables were statistically significant in influencing swimmers RSPG% mean scores: stroke-type, Olympic rank, distance and age ($P<0.01$). Using a hierarchical linear regression, these same four factors explained 9.2% of the variance influencing PB times.
Discussion
Our data (Bacon and Petersen, 2016) quantifies the success of swimmers preparations and scientists may reference this to help identify the difference between an anomalous versus an extraordinary performance. Coaches attempt to predict future performance times of leading competitors, while informed coaches could combine our data with knowledge of actual preparation strategies employed by specific swimmers or teams to assess the relative success of a given approach and ultimately inform coaching and tapering decisions.
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AGE-RELATED DECREASE IN PERFORMANCE OF MASTER ATHLETES IN SPRINT, SPRINT-ENDURANCE AND ENDURANCE EVENTS

SOUSA, C.V., AGUIAR, S.S., SIMÕES, H.G.
CATHOLIC UNIVERSITY OF BRASÍLIA

INTRODUCTION
Previous analyses on ranking trends of master athletes have demonstrated that long-distance runners might have a higher relative performance drop than sprinters (Ransdell, et al., 2009; Rittweger, et al., 2009; Nikolaidis, et al., 2016). However, although seems to be no discrepancies in literature regarding this non linear age-related performance decrease, the point in which this occurs has not yet been determined. Thus, we aim to analyse and compare performance trends among master athletes of 100, 400 and 10000m and objectively determine an age of breakpoint for a more pronunced performance decline.
METHODS
The sample was composed with official competition data from World Master Rankings. Age and performance data were collected from 2,937 athletes aged between 30 and 105 yr old, being 1,065 for 100m, 994 from the 400m, and 878 from the 10000m. Performance variables were plotted against age and calculated a trend line by polynomial regression for each event. The equations resulting from each regression showed a moderate determination coefficient. Furthermore, the vertices of the parabola trend line were calculated to identify the strongest age-related breakpoint.
RESULTS
Performance trend lines were calculated for each race indicating a non-linear performance drop with an increasing age. Race time presented a high coefficient of determination ($R2>0.8$) in 100m and 10000m, and moderate ($R2=0.74$) in 400 m. The x vertice indicates a breakpoint age of 67.9 yrs for athletes running the 100 m dash, 62.5 yrs for the 400m, and 63.8 yrs in the 10000m. The coefficient of determinations was high ($R2=0.80$) for the 100m and moderate for the 400 m ($R2=0.66$) and 10000m ($R2=0.79$).
DISCUSSION
Increasing age in men commonly leads to a body composition remodeling, decreasing both bone and muscle mass (Korhonen et al., 2012), and consequently leading to reductions in both aerobic capacity, muscle power and strength (Anawalt & Merriam, 2001). Although regular training delay these age-related effects on physical performance, mostly of master athletes reduce their training load to some extent as they age (Korhonen et al., 2010). These factors may lead to muscle adaptations that results in speed decrease, such as lower maximum strength of lower limbs muscles, slower rate of force development and transmissions and reduction in elastic energy storage and recovery in tendons (Stenroth et al., 2016). Therefore, we conclude that master athletes seem to reach an age where the performance decrease is no longer linear to aging.
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Sport Technology

VALIDATION OF THE PLAYSIGHT SMARTCOURT'S TENNIS SERVE SPEED MEASUREMENT.

OBERSCHELP, N., FETT, J., WIEWELHOVE, T., FERRAUTI, A.

RUHR-UNIVERSITY BOCHUM

Introduction
In modern tennis detailed match analysis is mostly reserved for professionals who play on courts that are video captured. To provide club level players with event-based visual feedback and tactical analysis in real-time, PlaySight SmartCourts were developed [1]. With four cameras in the court's corners motions of the ball and the players are tracked and analyzed and result in a variety of data. Amongst them is serve speed. For practical use the various functions the system offers as well as its affordance seem to be beneficial for training progress. Nevertheless it has to be evaluated if PlaySight is accurate enough to meet scientific criteria. In this study the serve speed was therefore compared to a criterion measure.
Methods
Four male tennis players (age: 25,3 ± 3,2 years, height: 182 ± 2,9 cm, body mass: 73,5 ± 7,6 kg) conducted a total amount of 30 valid serves from the deuce side. To distinguish between serve directions, the service box was divided into three equally large fields (wide, body, T). Initially the subjects served until 10 valid serves into the wide box were collected, followed by 10 valid serves to the body and 10 valid serves to the T. For each valid serve the speed displayed on the panel of a radar gun (S Pro II, Stalker, US) and on the PlaySight kiosk was registered. To minimize angle errors the radar gun was aligned according to the serve direction. Speed according to the radar gun was chosen as the criterion measure.
Results
Mean serve speeds according to the radar gun were 145,2 ± 16,6 km/h (wide), 158,0 ± 16,0 km/h (body) and 164,2 ± 21,2 km/h (T), respectively. Mean serve speeds according to PlaySight were 145,4 ± 17,1 km/h (wide), 156,9 ± 20,0 (body) and 161,9 ± 23,5 km/h (T), respectively. There were no significant differences in mean speeds ($2p > 0,05$). Mean deviation between the two systems was 7,1 ± 5,5 km/h (5,0 ± 3,8%, wide), 8,8 ± 7,9 km/h (5,6 ± 5,1%, body) and 8,6 ± 7,1 km/h (5,3 ± 4,2%, T), respectively. No significant differences in deviations between serve directions were identified. Maximal difference was 33 km/h. In 16 cases the deviation was above 10% and in 6 cases it was above 15%.
Discussion
While no difference between mean speeds could be identified, the large average deviation between systems is apparent. For speed measurement, an error of about 5% has to be taken into account. In the majority of cases where deviation was above 10%, serve speed according to PlaySight was non plausible. Inaccuracy in speed measurement might be due to a recording frequency that is too low (50 Hz). Besides, wrong ball localization could lead to deviations in speed computation.
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Contact
Nils.Oberschelp@rub.de

MUSCLE QUALITY AND FAT CONTENT EVALUATION USING ELECTRICAL IMPEDANCE MYOGRAPHY: INTER-DAY REPEATABILITY

VAGO, P.1, CASOLO, F.1, LONGO, S.2

1: UNIVERSITÀ CATTOLICA, (MILANO, ITALY), 2: SCIBIS, UNIVERSITÀ DEGLI STUDI DI MILANO (MILANO, ITALY)

Introduction
The assessment of muscle quality (MQ) is of considerable relevance when investigating changes in muscle, fat and connective tissue composition associated with use, disuse and ageing. Recently, Electrical Impedance Myography (EIM) has been proposed as a non-invasive approach for the assessment of MQ in patients with neuromuscular disease (Rutkove et al., 2009) and in patients affected by disuse atrophy (Tarulli et al. 2009). The present study aimed at assessing MQ and fat content (FM) in a population of healthy young participants and evaluate the inter-day repeatability of EIM measures with a novel and portable device.
Methods
25 participants (17M, 8F; mean±SD: age=26.6±5.2yrs; stature=1.74±0.08m; body mass=69.1±13.1kg) underwent two EIM measurements within the same week at the same time of the day. MQ and FM were assessed using a portable, battery operated, EIM device (Skulpt® Chisel), connected to a smartphone via Bluetooth®. EIM involves high-frequency (50KHz), low-intensity electrical alternating current applied to the muscle belly using 12 surface electrodes. Resulting voltages on the surface of the skin are detected and analyzed to produce EIM measurements by an internal algorithm. The device is applied on three body locations (triceps brachii, rectus abdominis and quadriceps femoris) for total MQ and FM estimations. Inter-day correlation coefficients with 95% confidence interval (ICC), and standard error of measurements as percentage (SEM%) were calculated. Paired Student's t-test was used to assess differences between measures ($p<0.05$).
Results
MQ values were 59.3±18.0 A.U. and 59.7±18.6 A.U., day 1 and 2, respectively ($p=0.633$). Inter-day ICC was 0.998 (0.997-0.999) with SEM%=3.38%. FM values were 21.2±5.4% and 20.9±5.1%, day 1 and 2, respectively ($p=0.469$). Inter-day ICC was 0.970 (0.900-0.998) with SEM%=4.31%.
Discussion
Assessment of MQ and FM by EIM employing a light, novel and portable device seems to yield highly reproducible results with very high inter-day ICCs and narrow confidence limits. Moreover, SEM values are low. Further studies are needed to compare Skulpt outputs with gold-standard techniques of body composition assessment (e.g. DEXA) to evaluate the validity of EIM in the assessment of MQ and FM, and for monitoring changes in MQ and FM induced by use and disuse.
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ACCURACY OF A MINITURIZED, FACE WORN VO2 ANALYZER

VAFA R., WEBER, S.
GERMAN SPORT UNIVERSITY COLOGNE

Introduction
Gas breath-by-breath analyzers are widely used tools in the training and testing of athletic performance. The size and footprint of these systems have shrunk over the years. Following this trend, the latest offspring of such trend is an entirely face-worn micro VO2 Analyzer ("VO2 Master Pro Beta V2", VO2 Master Health Sensors Inc., Canada). However, accuracy and validity of such small devices appear questionable.
Methods
A VO2 Master Pro Beta Version 2 gas analyzer utilizing a size "large" Venturi tube was attached to an automated respiratory gas exchange simulator (Vacumed Metabolic Simulator Model 17056, Gore et al.). The testing protocol consisted of 15 strokes at 5 different BF (12-59 min-1) at VT of 1,5L/2,0L/2,5L/3,0L/4,0L. FeO2 was adjusted to simulate VO2 of 1000mL;2000mL;3000mL;4000mL. Effects of simulated BF, VT and VO2 on measured BF, VT and VO2 was assessed.
Results
Measured and simulated values correlated significant ($p<0,01$); R2 values were: VO2=0,991; FeO2=0,981; BF=0,999; VT=0,999, VE=0,998. Measured vs. simulated VO2 values over all settings for 1000mL;2000mL;3000mL;4000mL VO2 were: 955mL±26,1; 1919mL±53,4; 2995mL±103,7; 3825mL±79,8. The coefficients of variation were: 2,73%; 2,78%; 3,46%; 2,09%.
No significant effect of neither BF nor VT on the accuracy of measured BF, VT, VE, FeO2 and VO2 ($p=0,00$). However, a non-significant tendency to underestimate VO2 for certain low-end BF at VT < 3L: for VT 1,5L at a BF <30 min-1; for VT=2L at a BF <40min-1 and for VT=2,5L at a BF <30min-1 was observed.
Discussion
For the full range of VT and BF tested in this study measured data were in good agreement with control values. Interestingly high BF did not alter the accuracy of the device, which seems important in testing competitive athletes. The tendency of underestimating VO2 at low VE, might be due to the use of the large Venturi tube only. It is recommended by the manufacturer to use smaller size Venturi tubes for low VE testing and even bigger sizes for high VE testing. The underestimation of VO2 values at high simulated VO2 seemed to be a result of an underestimating of VE. The accuracy determined by the coefficient of variation is similar to the most popular lab carts (Carter & Jeukendrup 2002) and even below some of the portable systems currently available on the market (Duffield et al.).
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Contact
Sebastian Weber [s.weber@staps-online.com]

Sports Medicine and Orthopedics

REGENERATION EFFECTS OF DEXTROSE PROLOTHERAPY ON CONTUSION INDUCED MUSCLE INJURY

TSAI, S.W., HUANG, C.C.
TAICHUNG TZU CHI HOSPITAL, BUDDHIST TZU CHI MEDICAL FOUNDATION

Introduction
Muscle and nerve injuries are frequent symptoms in sport rehabilitation clinics. The current treatment options for muscle injury remain suboptimal and often result in delayed/incomplete recovery of damaged muscle. The current project aims to evaluate the effects of Dextrose prolotherapy on inflammation and regeneration in skeletal muscle and nerve after contusion injury.
Methods
The gastrocnemius muscle of mice will be subjected to mass-drop injury (MDI) andmuscle samples collected after 7 days post-injury. Mice will be treated by injection therapy with (1)(Normal Control, NC、(2) post injury (MDI) without any treatment、(3) post-injury (MDI+10% Dextrose)、(4) post-injury (MDI+ 20% Dextrose)、(5) post-injury (MDI+ 30% Dextrose)、(6) with topically applied DCF (0.57 mg/kg) post-injury (MDI+DCF). The blood biochemistry, both macrophage and neutrophil infiltration will be assessed.
Results
The blood biochemistry data showed that the level of creatine kinase (CK) decreased significantly in the10% Dextrose and 20% Dextrose groups. The immunochemistry on muscle biopsy showed that the expression of Desmin increased significantly also in 10% Dextrose and 20% Dextrose groups when compared to NC and MDI groups. The inflammation marker F4/80 on macrophage also decreased significantly in 10% and 20% Dextrose groups.
Discussion
In this muscle contusion animal model, although our study findings showed the therapeutic effects in muscle contusion recovery process, the underlying mechanism of Dextrose prolotherapy still unclear. Muscle inflammation and following satellite cell expression is the recovery process after muscle injury(Scicchitano et al.). Recent studies suggest that myostatin has an important role in the regulation of skeletal muscle and ligament growth (Tsai et al.). In the future, further study is necessary to clarify the underlying association between myostatin, satellite cell regeneration and dextrose protherapy.
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Contact
swtsai@tzuchi.com.tw

THE EFFECTS OF 12-WEEK FUNCTIONAL TRAINING FOR POSTOPERATIVE POSTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

CHAO, W.C., SHIH, J.C., WU, C.L., LO, C.S.

SHOW CHWAN MEMORIAL HOSPITAL

Introduction

Posterior Cruciate Ligament (PCL) is the strongest ligament in the knee joint. The major function of PCL is to limit posterior shift of tibia in order to maintain knee joint stability. The incidence of PCL injury rises along with the posterior force exerted on tibia. Generally, PCL injury needs a long recovering period before going back on the field and there are a lot of sequelae resulting from the injuries.

Functional Movement Screen (FMS) is used to record the scores of movement patterns and grading system during normal functional movements. With the help of FMS, asymmetry movements can be detected promptly (Cook et al., 2006).

Use FMS to detect inadequate movements or muscle groups of the patients after PCL reconstruction. The patients were then undergone the additional individualized functional training during their rehabilitation program.

Methods

Fourteen patients undergone postoperative PCL reconstruction at least 3 months with no other complaints were recruited for the study. Before rehabilitation training, the patients were evaluated by using FMS, International Knee Documentation Committee scoring 2000 (IKDC), Lysholm Score and physical examinations (Kim et al., 2013). According to the results from FMS, the patients then participated in an individualized functional training program for 1 hour, twice a week, a total of 12 weeks in addition to traditional rehabilitation training. Subjects were evaluated again using FMS, IKDC and Lysholm Score after the training program.

Results

The result showed that the scores were improved in FMS, IKDC and Lysholm Score after training. ($p<0.05$) The average score of FMS was improved from 10 to 15; IKDC was improved from 61 to 70; Lysholm Score was improved from 58 to 81. These subjects were called back for stress films and MRI follow-up after 1 year. The results showed that the stress films were less than Grade 1. MRI showed the ligaments were progressingly growing in all subjects.

Discussion

The current study demonstrated a 12-week individualized functional training helps the patients with postoperative PCL reconstruction in daily activities, decreases the chance of re-injuries and improves their exercise performance. However, the outcomes were obtained from the limited numbers of PCL reconstruction case. To recruit more cases and control group is recommended in the future study. Finally, the current study suggested functional training could be included into rehabilitation program to prevent re-injuries.

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EFFECTS OF LOW-INTENSITY PULSED ULTRASOUND EXPOSURE ON MUSCLE REGENERATION AFTER CARDIOTOXIN-INDUCED MUSCLE INJURY.

SAKAMOTO, M.1, NAKAMURA, A.2, NAITO, Y.3, YONA, M.4, MURO, M.5, TADANO, C.5, MATSUNAGA, A.1

1: KITASATO UNIV. (JAPAN), 2: ODAWARA MUNICIPAL HOSP. (JAPAN), 3. KOKUSHIKAN UNIV. 4. TUPLS (JAPAN), 5. TOHO UNIV. MED. (JAPAN)

Introduction

Low-intensity pulsed ultrasound (LIPUS) is a common modality used for improving and enhancing connective tissue healing. Although several studies have reported the effects of LIPUS on muscle injury, the mechanism behind the effect of LIPUS remains unclear. This study aimed to examine whether LIPUS could promote the regeneration of myofibers, and if so, to investigate the underlying molecular mechanism.

Methods

Female, 12-week-old ICR mice were divided into muscle injury (non-US, N=25) and LIPUS exposure after injury (US, N =30) groups. Cardiotoxin was injected into the left tibialis anterior (TA) muscle to induce muscle injury. TA muscles were removed at 3, 5 and 7 days after injury. LIPUS was initiated 2 hours after injury to the left TA muscle and, thereafter, was applied once daily until 6 days post-injury. LIPUS was performed for 10 min/day, at a frequency of 3 MHz, intensity of 0.5 W/cm², 50 % duty cycle. The non-US group received sham LIPUS. At 7 days post-injury, frozen sections were reacted with anti-desmin antibody, and the fiber cross-sectional area (FCSA) was measured. At 3 and 5 days post-injury, the phosphorylation levels of Akt and p70S6K were measured by immunoblotting analysis. Results were analyzed using the unpaired t-test or Mann-Whitney with statistical significance at $p < 0.05$.

Results

Regenerating muscle fibers with central nuclei were observed in the injured area. FCSA of regenerating fiber varied in size from small to large. The mean FCSA of the non-US and US group was 674.9 ± 149.2 μm² and 789.5 ± 185.2 μm², respectively. There was no significant difference between the non-US and the US group at 7 days post-injury. Regarding the size distribution of FCSA, differences tended to be observed between the non-US group and US group. In the US group, the number of myofibers with FCSA > 1500 μm² was larger compared with the non-US group.

The phosphorylation levels of Akt and p70S6K were not significantly different between the US group and non-US group at 3 days post injury. Although no significant group-dependent differences were observed in the phosphorylation level of Akt, the phosphorylation level of p70S6K was significantly higher in the US group compared with the non-US group at 5 days post-injury.

Discussion

LIPUS promoted activation of p70S6K and an increase in the number of large myofibers following muscle injury. The activation of p70S6K by mechanical stimulation using LIPUS was Akt-independent. These results suggest that exposure with LIPUS has a beneficial effect on injured muscle.

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E FFECTS OF SHOUDER THROW, SHOULDER RANGE OF MOTION, AND SHOULDER INJURY IN ELITE JUDO PLAYERS

TEJIMA, R., FUKUDA, Y., TAMAI, Y., YAMAGUCHI, T., KOYAMA, K.
TOKYO ARIAKE UNIVERSITY OF MEDICAL AND HEALTH SCIENCE

Introduction
Shoulder injury occurs frequently in elite judo players. Their shoulder is subjected to tremendous stress through seoi-nage (shoulder throw), especially during lifting of the hand (tsurite). Of interest is a previous study that reported that gleno-humeral internal rotation (IR) deficit of the dominant shoulder is a risk factor of shoulder pain among baseball pitchers (Wilk et al., 2011). However, no reports have documented the shoulder range of motion (ROM) of judo players. We conducted two experimental studies as follows: (1) we examined associations between shoulder ROM and shoulder throw (study 1) and (2) between shoulder ROM and history of shoulder injury (study 2). Therefore, this study aimed to examine the relationship between shoulder throw, history of shoulder injury, and shoulder ROM in Japanese judo players.
Methods
The subjects were 48 Japanese elite junior high school and high-school male judo players recruited from the All Japan Judo Federation. Information on age, years of sporting experience, history of shoulder injury, and special skills were obtained by using questionnaires. In accordance with the questionnaires, we divided all the judo players into 2 groups as follows: the shoulder throw (ST) group (n = 24) and the non-ST group (n = 24). Shoulder ROM was measured while the participant was in the supine position. External rotation (ER) and internal rotation (IR) ROM were assessed in 90• abduction and 90• elbow flexion in lifting and pulling hand (hikite).
Results
The shoulder ER and IR significantly differed between lifting and pulling hand in the SN group (lifting hand vs pulling hand: IR, 53.6±13.3 vs 61.4±14.1; ER: 96.8±9.7 vs 84.6±11.9; $p<0.05$). In the non-SN group, shoulder ER and IR were found to be similar in both shoulders (lifting hand vs pulling hand: IR, 54.0±17.2 vs 60.9±15.1; ER, 84.9±18.9 vs 84.5±11.7). Regarding the history of shoulder injury, no significant difference was found between the judo players with and those without a history of shoulder injury in the SN group (study 2).
Discussion
In this study, we found no association between shoulder ROM and history of shoulder injury in elite judo players. This might be one of the reasons of the retrospective design of our study. Further studies are required to confirm our results by using a longitudinal study. In conclusion, the results of this study suggest a relationship of shoulder ROM to shoulder throw, but not to history of shoulder injury, in Japanese judo players.
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Contact
tejimar@tau.ac.jp

INJURIES IN AMATEUR FOOTBALL. COLLECTING DATA FOR INJURY PREVENTION.

FISCHER, F., GFÖLLER, P., HOSER, C., BLANK, C., SCHOBERSBERGER, W., FINK, C.
INSTITUTE FOR SPORTS MEDICINE, ALPINE MEDICINE AND HEALTH TOURISM

Introduction
Injuries in football are part of the game. Both UEFA and FIFA are concerned about the risk of injury and injury patterns in football, as awareness of injuries has increased [2]. While professional football is well researched [3], data for regional amateur football are scarce. Studying injuries is the first step to prevent them and to avoid the risks for the problems of repeated injuries [2]. Therefore, this study aims to collect data for a first step towards injury prevention.
Methods
A prospective cohort design was used to study football injuries in Austrian male amateur football players playing in the 3th and 4th tier during one season. Injury definitions and data collection procedures were applied according to the consensus statement on studies of football injuries [4]. Players gave their written informed consent to participate and data were collected on a monthly basis. The study protocol was approved by the Medical Ethics Committee of the Medical University Innsbruck, Austria.
Results
The final cohort consisted of 127 players (21.9±4.5years) from six teams. The mean team size was 21.2 (±3.2), ranging from 15 to 25 players per team. A total of 62 injuries were recorded, which represents an overall incidence of 4.05 injuries/1000 hours (CI 95% 3.11-5.19). 25 injuries were sustained during training (2.05 injuries/1000 hours, CI 95% 1.33-3.02) and 37 during match play (11.96 injuries/1000 hours, CI 95% 8.42-16.48). The total days of absence due to injury were 2342. In 29 cases, injuries were caused by a direct contact, 24 injuries were classified as non-contact and nine injuries resulted due to other reasons. The thigh (29%) represented the major location of injury, whereas 14 out of 18 injuries were non-contact muscle injuries.
Discussion
Non-contact muscle injuries are one of the main reasons for football injuries in this amateur football cohort. Although these injuries are not responsible for a long lay-off time, there are effective ways to easily avoid them [5, 6]. However, the implementation of injury-prevention programmes in the real world of sports represents a major challenge [1]. To convince football coaches, regional injury data should help to raise awareness for the implementation of preventive strategies.
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EFFECTS OF CORRECTIVE EXERCISE ON PELVIC ALIGNMENT, ASYMMETRY IN THE LOWER EXTREMITY MUSCLE STRENGTH AND MOBILITY IN A YOUTH SOCCER PLAYER: A CASE REPORT

KIM, A.R.1,2, LEE, S.Y.1, LEE, S.A.1, LEE, H.S.1

1. DANKOOK UNIVERSITY 2. NAMSEOUL UNIVERSITY

Introduction

When performing soccer tasks, the motions of the trunk and pelvis allow the stability and efficiency to perform soccer components such as kicking (Fonseca et al., 2011). The trunk-pelvic motion also contributes to the propulsive force necessary to accelerate the player's body in a new direction during sidestep cutting and crossover cutting (Fonseca et al., 2011). The routine practice of kicking may favor asymmetry in the capability of the athlete to stabilize the pelvis in the transverse plane (Santos et al., 2014). This asymmetry may develop not only in the lumbopelvic segment, but also in distal body segments (Dvorak et al., 2011). A lot of studies were reported injury prevention programs for soccer players, however there is lack of research on corrective exercise for impaired lower limb alignment in youth soccer player. Therefore, the purpose of this study was to determine the effects of corrective exercise on pelvic alignment, asymmetry in the lower extremity muscle strength and mobility in a youth soccer player.

Methods

A 11-year-old youth soccer player presented with anterior pelvic tilting (APT) and asymmetry in the lower extremity muscle strength and mobility. Corrective exercise program was performed for 40 min/day, twice a week for 8-week. Lumbosacral spine X-ray, range of motion (ROM) and strength of both lower limbs and functional movement screening (FMS) were measured before and after 8-week of corrective exercise.

Results

It was observed that improve in Cobb's angle at L1-S1 and sacro-horizontal angle, decrease in the differences of strength and ROM at flexion, extension, adduction and abduction of the hip joint, flexion and extension of the knee joint, and dorsiflexion and plantarflexion of the ankle joint, and increase FMS score after 8-week exercise than before.

Discussion

The youth soccer players who show marked asymmetry in the lower extremity muscle strength and mobility involving the lumbopelvic alignment may have higher incidences of injury, therefore suffering greater chances of premature interrupting their soccer careers and not reaching the professional category (Willson et al., 2005). These results of this case report suggest that corrective exercise improve pelvic alignment, asymmetry in the lower extremity muscle strength and mobility asymmetry in a youth soccer player. These findings have clinical implications for corrective exercise in youth soccer players who frequent asymmetric motion.

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Contact

hoseh28@dankook.ac.kr

LATENT MUSCLE REACTION TIMING OF SHOULDER MUSCLES IN BASEBALL PITCHERS: COMPARISON WITH TRANSITIONAL PERIODS OF PAST THROWING INJURY HISTORY

TSUGA, Y.1,2, YAMAMOTO, Y.2, YOSHIDA, N.1, KATO, H.3, HIRONO, J.4, SUNAGAWA, N.1, MIYAKAWA, S.2

1: TEIKYO HEISEI UNIVERSITY(TOKYO, JAPAN), 2: UNIVERSITY OF TSUKUBA(IBARAKI, JAPAN), 3: TEIKYO UNIVERSITY(TOKYO, JAPAN), 4: SHINSHU UNIVERSITY(NAGANO, JAPAN)

Introduction

Throwing injury is common problem in baseball players. Researchers proposed many rehabilitation programs of throwing injury, including flexibility, strength and neuromuscular exercise. However, few previous studies reported relationship the between throwing injury and neuromuscular function of shoulder muscles. The aim of this study was to evaluate the latent muscle reaction timing (MRT) of shoulder muscles in baseball pitchers, and compare it by each transitional periods of history of throwing injury.

Methods

The subjects were asymptomatic collegiate baseball pitchers and control group. Baseball pitchers were classified into High Risk Group (HRG; with previous history of throwing injury less than a year) and Low Risk Group (LRG; with previous history of throwing injury more than 2 years). The MRT of the infraspinatus, deltoid posterior, serratus anterior muscles and all parts of the trapezius muscle were measured during sudden internal rotational perturbation of the glenohumeral joint.

Results

The MRT of infraspinatus and middle trapezius were later than that of LRG and control group ($p<0.05$). In HRG, the MRT of infraspinatus was later than that of deltoid posterior, serratus anterior, upper trapezius ($p<0.05$), and the MRT of middle trapezius was later than that of infraspinatus, deltoid posterior, serratus anterior, upper trapezius and lower trapezius($p<0.05$).

Discussion

Ishii et al.(2010) reported that risk factor of throwing injury was the baseball pitchers with previous history of throwing injury less than a year. Therefore, this study suggested that there was relationship between the history of throwing injury and the neuromuscular function.

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Contact

y.tsuga@thu.ac.jp

THE EFFECT OF PRESS TACK NEEDLE ON MUSCULAR POWER OUTPUT DURING KNEE EXTENSION EXERCISE - SHAM-CONTROLLED STUDY -

KANEKO, Y., FURUYA, E., TSUNODA, N., SAKAMOTO, A.
KURETAKE COLLEGE OF MEDICAL ARTS AND SCIENCES

Introduction
In previous study, we demonstrated acupuncture stimulation on lumber region prevented the fatigue caused by repetitive heavy isokinetic exercise and sustained generating the power output on knee extensor. The aim of present study was to examine the effects of press tack needle stimulation on muscular power output during isokinetic knee extension exercise.
Methods
Twelve competitive triathletes (21.5±2.8 yr, 173.4±5.5cm, 64.5± 3.3kg) performed repetitive isokinetic knee extension exercise (5 sets of 30 repetition, angular velocity: 60°/s, 3 min rest between each set) after 1) press tack needle (Pyonex, Seirin Co.; length: 0.6mm, ϕ 0.2mm) stimulation on quadriceps (WHO-SP10, ST34) (PQ), 2) press tack needle stimulation on lumbar region (WHO-BL24, BL26) (PL), and 3) sham press tack needle on lumbar region as same as PL (CNT). The sham press tack needle was as same as real press tack needle except the needle had been removed by manufacturer. Peak torque (N) and total work (J) were observed.
Results
Peak torque of CNT was decreased in latter sets (200.2±15.7, 194.1±18.2, 180.7±20.2, 174.2±19.4, 172.8±14.5, first, second, third, fourth, fifth sets, respectively), and there was significant differences between the first and the fourth and fifth sets ($p<0.05$). No significant differences were observed in PQ (178.8±29.6, 182.4±30.6, 174.6±31.0, 171.4±30.3, 164.8±26.9, respectively) and PL (188.7±18.2, 193.0±19.2, 189.8±16.5, 185.9±16.6, 188.0±20.9, respectively). For total work, significant decrease was observed in CNT (5054±600.5, 4722±723.2, 4516±675.1, 4423±666.9, 4359±584.4, respectively) on the third, fourth, and fifth sets compared to the first set while no significant differences were observed in PQ (4706±597.4, 4632±614.7, 4400±596.6, 4341±531.4, 4386±557.8, respectively), and PL (4675±528.4, 4725±577.7, 4743±719.8, 4629±696.1, 4652±680.5, respectively). .
Discussion
These results suggested press tack needle stimulation during the isokinetic exercise of knee extensor was effective to prevent the fatigue caused by repetitive heavy exercise and sustain generating muscular power output when applied on both lumbar region and quadriceps. These results partly agree with previous studies (Hübscher:2010, So:2007, Toma:1998) although these data were detected by isometric exercise and selected acupuncture points were different. It is considered that even very small amount of acupuncture stimulation as present study, causes physiological phenomenon such as increasing oxygenation at both local (stimulated) and distant (not stimulated) muscles in the same innervation (Kaneko et al., 2016) or alleviating pain (Vickers et al., 2012). It is considered that press tack needle lead more appropriate delivery of arterial blood flow into deoxygenated muscles by exercise as well as regular acupuncture stimulation so that it could help re-oxygenation during resting period between the repetitive isokinetic exercises, and analgesic effect of acupuncture suppressed corresponding pain during heavy exercise and maintained the muscular power output.

DISTINCT EXPRESSION OF THE TNF-ALPHA RECEPTORS IN NERVES WITH AXONAL LOSS - STUDIES ON TENDINOPATHIES

RENSTRÖM, L., SPANG, C., FORSGREN, S.
ANATOMY

Introduction
Tendinopathy is a painful condition. Nearby the tendon there is the peritendinous connective tissue that can be of great importance in causing pain and discomfort for patients with tendinopathy. There are frequent nerve fascicles, blood vessels and dispersed cells in this tissue. One system that can be of importance in the tissue is the TNF-α system. It is, however, not known how TNF-α and its receptors TNFR1 and TNFR2 are expressed for these structures.
Methods
The purpose for this study was therefore to evaluate for the expression patterns of these in the peritendinous tissue located between the two anatomically wellknown Plantaris and Achilles tendons and the connective tissue located superficially to the extensor origin at the elbow region for patients with tendinopathy/tennis elbow.
Results
The nerve fascicles were found to be of two types. One type being homogenously stained for the nerve markers βIII-tubulin and neurofilament and the other showing deficits in reaction for these. The latter is thus showing features of axonal damage. Much more distinct TNFR1 and TNFR2 immunoreactions were seen for the latter nerve fascicles. TNFR1 was seen for axons and TNFR2 mainly for Schwann cells.
Discussion
These findings suggest that the TNF-α system can be related to degenerative events but presumably also attempts for healing concerning the nerve structures. TNFR1 and particularly TNFR2 immunoreactivity were seen for parts of the blood vessels. The dispersed cells showed frequently TNFR1 and TNFR2 immunoreactivity. It is on the whole concluded that the TNF-α system is much represented in the peritendinous tissue why this cytokine can have a great impact in this tissue in tendinopathy/tennis elbow.

INTRACLASS RELIABILITY OF THE ANTERIOR TALOFIBULAR LIGAMENT AND ANTEROINFERIOR TIBIOFIBULAR LIGAMENT MEASURED BY USING STRESS ULTRASONOGRAPHY

TAMAI, Y., FUKUDA, Y., TEJIMA, R., KOYAMA, K.
TOKYO ARIAKE UNIVERSITY OF MEDICAL AND HEALTH SCIENCES

Introduction
Ankle sprains are the most frequent injuries sustained by athletes. A previous epidemiological study reported that the most common ligament injury pattern was isolated anterior talofibular ligament (ATFL), followed by ATFL plus calcaneofibular ligament, and ATFL plus anterior inferior tibiofibular ligament (AITFL) among high school athletes (Swenson et al.2013). A recent study reported that ATFL with ankle sprain was identified by using stress ultrasonography (SUS). However, the ankle position during measurement of ATFL on SUS vary. In addition, the intraclass reliability of ATFL remains unclear. Therefore, the purpose of this study was to measure the extension distance of the ATFL in an anterior drawer test (ADT) and inversion stress test (INV) by using SUS, and to examine intraclass reliability and AITFL.

Methods
The study population included 7 men and 6 women (16 feet). The mean age and years of sports experience of the population at the time of examination were 21.8 ± 0.6 and 7.5 ± 3 years, respectively. In ATFL, both stress tests were performed at 0°, 15°, ad 30° plantar flexion by using a stress device. The AITFL examination was performed by using external rotation (ER) and internal rotation (IR) of the foot in 10° dorsiflexion, 0°, and 10° of plantar flexion manually. All ultrasonographic recordings were performed three times at 7-day intervals by one operator. Analysis of variance was used to estimate the intraclass correlation coefficient (ICC).
Results
The intraclass reliability of ATFL at 15° plantar flexion was high (ICCs, 0.977 and 0.986 for ADT and INV, respectively). By contrast, the intraclass reliability of ATFL at 0° plantar flexion was moderate to high (ICCs, 0.880 and 0.530 for ADT and INV, respectively). The intraclass reliability of AITFL at an ER of 0° plantar flexion was high (ICCs, 0.844). The intraclass reliability of AITFL at an IR of 10° plantar flexion was moderate (ICCs, 0.617).
Discussion
In this study, the intraclass reliability for measurement of ATFL at 15° plantar flexion and AITFL at 10° plantar flexion rather than 0° plantar flexion was high. In conclusion, the intraclass reliability of ATFL and AITFL during ultrasonography might affect the ankle position.
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Contact
y-tamai@tau.ac.jp

FALLS IN MOUNTAIN HIKERS ARE MAINLY CAUSED BY SLIPPING – PRELIMINARY RESULTS OF A 3-YEAR PROJECT

FAULHABER, M., POCECCO, E.
UNIVERSITY INNSBRUCK

Introduction
Mountain hiking, defined as walking in a mountainous environment predominantly on marked trails and paths, represents the most attractive mountain-sport activity in the Alps during the summer season (Burtscher et al., 2007). However, the risks of mountain hiking include cardiovascular emergencies and accidents caused by falls (Faulhaber et al., 2012). Up to know the reason and mechanisms of falls in mountain hikers remain elusive. Therefore, the present pilot project attempted to get information on the primary reasons of falls in mountain hikers.
Methods
The present abstract focuses on a preliminary analysis of selected parameters determined within a 3-year project in Tyrol (Austria) and comprise data of the first year (May to October 2016). Victims of non-fatal mountain-hiking accidents were sent a questionnaire by the Austrian Alpine Police. Demographic and anthropometric details and a description of the accident by the victim, which were part of the questionnaire, were analyzed for this abstract.
Results
Data of 129 victims could be included into the analyses (corresponding to a response rate of about 50 %). Victims were characterized as follows: mean age 57±15 years, mean body height 170±9 cm, mean body weight 71±12 kg, 56 % were female. Falls were caused by slipping in 63 % of the female and in 49 % of the male victims. Stumbling was responsible for 10 % and for 14 % of the falls in female and male hikers respectively. 15 (females) and 14 % (males) of the hikers sprained an ankle and fell without slipping or stumbling before. Other reasons were recorded in 13 % (females) and 23 % (male) of the victims. There was no significant difference in the distribution between female and male hikers ($p = 0.32$ by Chi-Square-test).
Discussion
The present data suggest that slipping on stony paths, on (wet) grass and in some cases on snow is the predominant reason for falls in mountain hikers. Although the results represent data of 1 summer season and have to be interpreted with caution, fall prevention for mountain hikers should target slipping prevention as an important reason for mountain hiking accidents. Further investigations should identify potential factors (e.g. equipment, behavioral aspects) related to falls in mountain hikers.
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Training and Testing

CHANGE OF PHYSICAL AND FUNCTIONAL CAPACITY IN ROWERS DURING THEIR PREPARATION FOR OLYMPIC GAMES 2016

MILASIUS, K., DADELIENE, R.
LITHUANIAN UNIVERSITY OF EDUCATIONAL SCIENCES

Introduction
Lithuanian double scull rowers successfully participated in the Olympic Games of Rio de Janeiro and won silver medals. The aim of this work was to investigate the features of the change in Lithuanian elite rowers' physical and functional capacities during yearly cycle, in their preparation for the Olympic Games.
Methods
Seven Lithuanian rowers, the members of the national Olympic team, participated in the research. Athletes' body development, special anaerobic alactic power, aerobic capacity at the limits of anaerobic threshold and of critical intensity were established.
Results
During the final yearly preparatory cycle for the Olympic Games, rowers' aerobic capacity was in remarkable progress, their VO2max reaching 60-65 ml/kg/min – the data characteristic to the rowers of similar mastership level, as presented in literature sources. Jürimäe et al. (1999) scientifically proved existence of close correlation (r=0.56) between the indices of work power and oxygen intake at anaerobic threshold. Maximal and average absolute and relative anaerobic alactic muscle power of our investigated athletes had a tendency to increase during yearly cycle, from the beginning of preparatory period up to competitive period, however, this increase was not statistically significant. The training loads applied during yearly training cycle had a positive effect on the change of aerobic capacity indices at

the limits of anaerobic threshold and of critical intensity. Same results of the investigations are presented by Izquierdo-Gabarren et al. (2010) and Smith, Hopkins (2012). Remarkable VO2max increase was established: from the beginning of preparatory period up to competitive period, it used to increase in average from 47.4±2.4 to 62.9±1.8 ml/kg/min. During the period of the investigation, statistically reliable increase was established in other aerobic capacity indices at critical intensity limit, too.
Discussion
An increase of the indices of Lithuanian rowers' aerobic capacity at anaerobic threshold limit was statistically significant. The level of these indices corresponds to the level of the strongest world rowers' aerobic indices. Training process of the investigated Lithuanian elite rowers was properly managed. Rowers' physical and functional abilities progressed during yearly training cycle, and these factors were of influence for the athletes' excellent participation and achievements in international events. Lithuanian double scull rowers were the silver medal winners in 2016 Rio de Janeiro Olympic Games.
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STUDY OF MEAN POWER, PEAK POWER, MINIMUM POWER, TOTAL WORK IN MODERN PENTATHLON ATHLETES OF KNSU

YOON, J.R., KIM, Y.S.

KOREA NATIONAL SPORT UNIVERSITY

Introduction
The purpose of this study was to investigate maximal anaerobic power and capacity in modern pentathlon athletes of korea national sport university(KNSU).
Methods
This study was performed by 22 modern pentathlon athletes in KNSU (n = 22, age = 19.8 (± 1.1), weight = 70.1 (Ayalon, Inbar, Bar-Or. 1974, 1977, 1980). The Wingate anaerobic test consists of a single all-out 30-second sprint against a constant braking force that is determined according to the participant's body weight. As a typical method for evaluating anaerobic power and capacity, after recovery from the warm-up, the participants were instructed to acceleate maximally and maintain a maximal pedaling velocity throughout test during which a bicycle ergometer (Lode BV, Excalibur Sport, Netherland) was used for 30 seconds. They were given verval encouragement during the test and the pedaling rate was recorded during the sprint. Measurement variables are MP(mean power; mean power/weight), PP(Peak Power; peak power/weight), MP(minimum power), TP(time to peak power), RF(rate to fatigue), TW(total work) by Wingat test. At this point, the individual bicycle friction load (brake strength) applied to the subjects was 0.075kp for male and 0.05kp for female and they were audiologically encouraged to exercise their maximum power during the measurement.
Results
As a result measured by these methods in modern pentathlon athletes of korea national sport university, it has been shown that Mean Power=660.9(±44.67)watts; Peak Power=753.5(±70.1)watts, Minimum Power= 556.9(±39.9)watts, Time to Peak Power=6.4(±1.6), Rate to Fatigue=8.3(±2.9), Peak Power/Weight=10.8(±0.8)watts/kg, Mean Power/Weight=9.4(±0.6)watts/kg, Total Work=19,850(±1,335.2)Joules, respectively.
Discussion
Thus, the results of this study are lower than the world-class levels of speed skaters and found to be similar to those of biathletes and triathletes. So these results suggest that modern pentathlon athletes in KNSU require specific anaerobic training programs for enhancement of athleletic performance.

DETERMINATION OF ANAEROBIC CAPACITY - RELIABILITY AND VALIDITY OF SPRINT RUNNING TESTS

WAWER, C.1,2, YANG, W.H.1,2, HEINE, O.2, PREDEL, H.G.1

1: GSUC (COLOGNE, GERMANY), 2: OTCR (COLOGNE, GERMANY) 1:GERMAN SPORT UNIVERSITY COLOGNE, 2: OLYMPIC TRAINING CENTRE RHINELAND

Introduction
Several physiological diagnostic tests have been used to ascertain individual performance capability in professional sport. Incremental step tests protocols on running tracks, treadmills and ergometers (cycling, rowing, arm crank) are well established in professional sport for this purpose. In contrast, protocols to determine anaerobic, glycolytic capacity are less common .To avoid invasive methods, the parameter for the maximal glycolytic capacity is the rate of the maximum lactate production (LPRmax) and has been used as an indicator for anaerobic lactic capacity (Mader & Heck, 1994).
Methods
The objective of this study was to evaluate the reliability and validity of a linear sprint run test to assess the anaerobic capacity in athletes from different sports. LPRmax was used to classify anaerobic capacity. The study was divided into three parts. Participants performed several linear sprints on a running track (LSRT) with different time durations (8, 10, 12, 14 seconds) (part I) on different days, and a 10 or 12 second sprint run on a nonmotorized treadmill (NMT) (part II). In part III, athletes ran a 10 second LSRT and NMT on consecutive days. Capillary blood sampling was used to measure lactate level at the time of the step test, and before (Lacr) and after the sprint run for ten minutes at one minute intervals to find out maximal lactate concentration after exercise (Lacmax) and to calculate LPRmax.
Results
For all parts of study reliability for LPRmax was proven (Part I: 8s of 2 days: ICC: r=0.89; 10s of 2 days: ICC: r=0.82; 12s of 2 days: ICC: r=0.92; 14s of 2 days: r=0.84, respectively; Part II: 10s: ICC: r=0.76; 12s: ICC: r=0.79). To check validity for LPRmax, Part III was conducted and proven valid (ICC: r=0.96, P=0.074).
Discussion
We demonstrate that LSRT and NMT reliably determine anaerobic capacity and can be used as a valid tool for physiological performance diagnostics. For physiological performance diagnosticians, sprint tests to determine anaerobic capacity are an additional tool to appreciate an athlete's performance level. It is evident that disparity in profiles of qualification level is revealed via different diagnostic tools but LPRmax in combination with VO2max can be used to provide additional information for generating training programs.
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Contact
c.wawer@dshs-koeln.de

INTER-RATER AND INTRA-RATER RELIABILITY OF STAR EXCURSION BALANCE TEST IN SCHOOL BOYS

NG, S.K., CHEUNG, C.W., SUM, K.W.
THE CHINESE UNIVERSITY OF HONG KONG

Introduction
The purpose of this study is to establish the inter-rater and intra-rater reliability of star excursion balance test (SEBT) for balance assessment in anterior, posterior-lateral, posterior-medial directions of dominant and non-dominant legs in boys with age between 6 and 13 years.
Methods
Forty-two school boys aged 6-13 years old were recruited without musculoskeletal, cardiovascular, vestibular, visual, neurologic disorder or surgery within 6 months at the time of recruitment. The procedure was explained to children. Consent was received from their parents. No previous SEBT experience was recorded among all participants. Their leg length on both legs was determined from the anterior superior iliac spine to the medial malleolus of the same leg while laying supine on the floor. The average of the sum of both left and right leg lengths was used to normalize excursion distances by dividing the distance reached by leg length and then multiplying by 100. All the SEBT was conducted during physical education (PE) lesson. After performing four trials of SEBT at randomized directions, the participants completed 2 trials in randomized order of leg tested and order of reach direction with a 10-second break between trials and 20 seconds between directions on first day by both raters to test inter-rater reliability and by first rater after 6 days to test intra-rater reliability. Only the best of two measurements was recorded for each directional reach for statistical analysis. Data obtained was analyzed using Cronbach's alpha (α), Interclass Correlation Coefficient (ICC), Standard Error of Measurement (SEM = SD*(√(1-ICC))), Minimum Difference (MD = SEM*1.96*√2). The level of significance was preset at .05 for all analyses.
Results
Their mean age and body mass index (BMI) is 9.71±2.00 years and 17.41±3.70 kg m2 respectively. Average leg length of left and right is 71.90±8.51cm. For the three directional reaches of both dominant and non-dominant legs, the intra-rater reliability of SEBT was found: α = (0.49-0.88), ICC = (0.50-0.88), SEM = (3.03-7.47), MD = (8.38-20.70), whereas the inter-rater reliability of SEBT was reported: α = (0.64-0.85), ICC = (0.63-0.82), SEM = (3.96-7.24), MD = (10.97-20.08). The reaches between dominant and non-dominant legs were significant correlated with coefficient ranged from 0.41 to 0.63. No significant difference was observed between the use of the dominant leg and the non-dominant leg as the supporting leg.
Discussion
SEBT has shown moderate to excellent inter-rater and intra-rater reliability when the test was conducted in PE lesson, regardless whether dominant or non-dominant legs was used as the supporting leg. Thus it can provide a reliable, time saving and interesting test to assess dynamic balance in boys of 6-13 years old.

ANTHROPOMETRIC CHARACTERISTICS OF MALE AND FEMALE SPORT CLIMBERS IN JAPAN

HAKAMADA, N., NUMAZAWA, H.
RIKKYO UNIVERSITY

Introduction
Sport climbing has become popular in the last decade and will be included in the 2020 Tokyo Olympic Games. Although there is a growing number of studies focusing on sport climbers' physical profiles, research about anthropometric characteristics of sport climbers is not sufficient. Thus, the aim of this study was to clarify anthropometric characteristics of sport climbers compared to non-sport climbers for establishing criteria to apply in talent identification.
Methods
The data of 23 measurement items from 42 top-level athletes and recreational climbers (27 males and 15 females) were collected using the Martin-type instrument and the body composition meter. The measurement was proceeded according to Martin & Saller's method (Martin et al. 1957). 7 anthropometric indices were calculated after the measurement process. Data collected from the subjects and the calculated indices were then compared with the physical fitness standard value of Japan (Tokyo et al. 2007). Further, inter-correlations between all the variables and the subjects' maximum climbing abilities in French scale were investigated.
Results
Male sport climbers had a significantly thicker forearm girth, narrow pelvis width, thinner thigh girth, calf girth , lighter weight, a higher upper extremity girth index score (UEG, forearm girth to arm girth ratio), ape index score (arm span to height ratio), upper limb length-height ratio and lower weight-height ratio than the controls. On the other hand, the female sport climbers had a significantly longer lower limb length, wider shoulder width, shorter upper limb length, hand length, thinner forearm girth, calf girth, a higher ape index score, lower limb length-height ratio, lower pelvis-shoulder index score, UEG score, and an upper limb length-height ratio. In addition, there was no significant correlation between all the variables and the climbing abilities.
Discussion
We found that the ape index score, for which the sport climbers' scores have been higher than the controls of both male and female, is one of the standard points to assess whether the climber has a considerable aptitude for sport climbing or not. However, as there was no correlation between the measurement scores and the climbing abilities, the anthropometric characteristics are not a determining factor for climbing abilities. The result of this study shows that longer upper extremities are a minimum requirement for sport climbers, but the examination of effects from technical and physical factors is important to entirely clarify the structure of sport climbers' performance.
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Contact: hakamadanaoto@gmail.com

THE EFFECTS OF HOME-BASED RESISTANCE-TRAINING PROGRAMS AND MOTIVATIONAL EDUCATION ON JUNIOR HIGH SCHOOL BASEBALL PLAYERS

TERADA, K.1,2, SHIRAISHI, A.1,2, KOBAYASHI, Y.2, KAWAKAMI, K.2, NAKAGAWA, T.2, NADAMOTO, M.3, NAKATANI, T.1,2
1: TENRI UNIVERSITY (TENRI, JAPAN), 2: TENRI UNIVERSITY GRADUATE SCHOOL (TENRI, JAPAN), 3: POOLE GAKUIN UNIVERSITY (SAKAI, JAPAN)

Introduction
Junior high school students face difficulty in dedicating time to resistance training and other related athletic activities due to time required for practice and study. We conducted this study to investigate the effects of home-based, resistance-training programs and motivational education on members of a junior high school baseball team.
Methods
Twenty-five junior high school baseball players (mean age: 13.4 ± 0.4 years) without diseases or impairments of the musculoskeletal system were enrolled in this study. Their exercise regimen consisted of home-based training (Rooks et. al., 1997), which included both (i) resistance training of the upper (push-up) and lower (squat) limbs as well as of the abdominal muscles (sit-up), and (ii) plyometrics training (i.e., single leg rebound jump and sprit jump) using one's own bodyweight, in addition to motivational education (Dorgo et. al., 2009). Exercise intensity was measured using the OMNI Resistance Exercise Scale (OMNI-RES, on a 10-point scale). Study subjects performed repetitions until they reached a perceived exertion intensity of 8 out of 10 for 4 weeks (Robertson et. al., 2003). The outcome measures included the frequency of exercises and the number of push-ups, sit-ups, single leg rebound jumps, and sprit jumps. Evaluation parameters such as subjective leg pain caused by delayed onset muscle soreness and motivation to exercise were measured using a questionnaire.
Results
There were no incidents of injury or musculoskeletal damage caused by this exercise program. After 8 weeks of training, we identified significant increases in the frequency of exercises and the numbers of all exercise items (push-ups, sit-ups, single leg rebound jumps, sprit jumps). Furthermore, the score of some items from the questionnaire that measured motivation were significantly increased following motivational education.
Conclusion
Introduction of home-based training using one's own bodyweight and educational intervention for junior high school male baseball players is likely to be effective. This is likely due to changes in consciousness about training and in increases in the frequency of the implementation of voluntary training.
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Contact
terada@sta.tenri-u.ac.jp

HIGH INTENSITY INTERVAL TRAINING IMPROVES CARDIO- RESPIRATORY FITNESS OF VARSITY FEMALE BALL PLAYERS

KIMURA, Y., HISATOMI, M.1, OHKI, K.1,2, IKEGAMI, T.1, NAKAGAWA, N.1, SHIMADA, M.3, YAMAZAKI, S.1,4
INSTITUTE OF FITNESS AND HEALTH SCIENCES

Introduction
The physical requirements for female ball plyers appear to be similar to those of for men, with high levels of aerobic capacity, sprint speed and recovery being fundamental for success. In male ball players, several previous studies have been assessed to improve training status. However, there are a few studies have examined the responses to training interventions in female ball plyers and the most effective method remains to be determined. The purpose of this study is to examine the effects of three training interventions on the cardio-respiratory fitness of varsity female ball players.
Methods
Twenty-five varsity female ball players (handball=6, basketball=7, soccer=9, rugby football=3) participate in this study. Maximal oxygen uptake (VO2max) was predicted using the reference tables. Aerobic capacity was assessed by a 20-m multi-stage fitness test (1). Anaerobic capacity was assessed using a 5-m multiple shuttle test (Boddington et al. 2001). Participants were then matched for VO2max and randomly assigned to one of three training groups, first – high intensity interval training (HIIT: 30 sec shuttle runs with 30 sec rest), second – interval training (IT: 4 min running at 90% HRmax followed by 3 min rest), third – continuous training (CT: 28 min run at 75% HRmax). Each training program was time-matched, consisting of three 28 min training sessions per week, for six weeks.
Results
There were no significant differences in age, height, body mass and pre-training predicted VO2max among the three training groups. Aerobic capacity increased significantly in both HIIT and IT groups (HIIT: 10.2±4.5%; $p<0.001$, IT: 6.6±2.5%; $p<0.01$) and increased in CT (3.8±4.6%). The distance covered during the anaerobic performance test increased in all groups, but only in HIIT significant (HIIT: 31±19 m; $p<0.01$, IT: 14±18 m, CT: 13±18 m).
Discussion
The HIIT results in significant increase in both aerobic and anaerobic capacity and therefore appears to be an effective method of cardiovascular fitness training for female ball players.
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Contact
e-mail address:yasuok1944@yahoo.co.jp

EFFECTS OF SPECIFIC PROGRAMMED TRAINING ON MORPHOLOGICAL CHARACTERISTICS, MOTORIC AND FUNCTIONAL ABILITIES OF ELITE JUDOKAS

DRID, P., MEKIC, A., RADJO, I., TRIVIC, T., OSTOJIC, S.M.

FACULTY OF SPORT AND PHYSICAL EDUCATION, UNIVERSITY OF NOVI SAD

Introduction

Judo is a dynamic, highly intense intermittent sport that requires complex skills and tactical excellence for success (Dégoutte et al., 2003). Judokas during matches perform a great variety of actions whereas requirements of each match are extremely high (Franchini et al., 2013; Drid et al., 2015). The aim of this research was to determine the effects of specific programmed training on morphological characteristics, motoric and functional abilities of elite judokas.

Methods

Fourteen male judokas participated in the study. The elite group, consisted of 7 athletes, the sub elite group consisted of 7 athletes.

Results

Effects of program showed statistically significant changes in tests of absolute strength in favor of experimental group in following variables: Bench Press, Deep squat, Dead lift and Hand Grip Right. In variables of power evaluation effects of applied treatment were also significantly better in favor of experimental group with verical jump, standing long jump and Medicine ball toss. Better results for experimental group were also found within muscle endurance variables, Chin up, Bench Press with body weight and Squat with body weight. In addition, significant effect of changes on average values were determined with Coordination with stick, Envelope test and side leg raise, all in favor of experimental group. The effect of applied program on absolute oxygen consumption variable is found statistically significant. Furthermore, it has been determined statistically significant effect of program on following variables: Speed at maximal oxygen consumption, Relative oxygen consumption at ventilatory threshold, Maximal anaerobic power test in watts. Variable that determines specific abilities of judokas, 30 seconds Tokui Waza effects of the applied treatman was statistically better in favor of experimental group.

Discussion

The research will help judo coaches to distinct the effects of the applied specific training programe, and incorporate and adopt the programe to their training in practice.

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POWER OF LOWER LIMBS AND MAXIMUM SYMPTOM-LIMITED EFFORT OF WOMEN'S BASKETBALL AND VOLLEYBALL TEAMS OF PREMIER POLISH LEAGUE

OZIMEK, M.1, SZMATLAN-GABRYS, U.1, GABRYS, T.2, STANULA, A.3

1: AWF (CRACOW, POLAND), 2: PWSZ (OSWIECIM, POLAND), 3: AWF (KATOWICE, POLAND).

Introduction

In the specific speed of the team sport games player, in the component of his motion a very important role is played by muscle and energy factors, which include the rapidity of impulse or explosive power Hönle (1996). Today, these abilities are also defined as the rate of power development (RPD) or rate of force development (RFD). RPD or RFD are of crucial importance for the movements lasting up to 250 ms, while for the movements lasting more the greater role is attributed to the maximum power (Golas and Hare 2016). The main goal of the study was to determine the level and impact of the maximum symptom-limited effort on the power of lower limbs in women's basketball and volleyball teams of Premier Polish League.

Methods

The investigations embraced 15 basketball players and 10 volleyball players from women's teams of First Polish League. The testing program: Warm-up. Assessment of lower limbs power (before and after physical effort) – Tests; SQUAD JUMP and CMJ (Modular OptoJump Next). The aerobic efficiency - BIP TEST- with increasing of physical loads every 3 minutes and biochemical investigation (K4b2 Cosmed, BIOSEN C - line).

Results

Our study clearly indicates the need to verify the effects of existing training methods (in this case of basketball and volleyball Premier Polish League) on the lower limbs power level during the preparation period and the use of strength exercises for its formation. It is an essential element of training of basketball and volleyball players, both under resting conditions and in conditions of fatigue, specific to sportsmanship.

Discussion

Many sports are oriented primarily on the desire to develop the maximum torque (powerlifters, hammer putter).Other primary goals of training are mainly the strengthening of selected muscle groups in the absence of body weight increase (ski jumping, high jump). A number of disciplines requires the strengthening of lower limbs and trunk muscles (sprints athletics, football, volleyball, basketball), as some of them emphasize the increasing muscle strength of the trunk and upper limbs (rowing, canoeing) (Ozimek et al. 2014 Staszkiewicz et al. 2006).

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Contact

Mariusz Ozimek, mozime@poczta.onet.pl

COMPARISON OF TRUNK FLEXION MUSCLE POWER BY PLAYER POSITION IN VOLLEYBALL

OKAWA, M.1, SAKAI, M.2, IDE, Y.3, SAKURAI, T.4

1 AND 4: NIPPON SPORT SCIENCE UNIVERSITY, 2: KYUSHU WOMEN'S UNIVERSITY, 3: KYUSHU UNIVERSITY OF NURSING AND SOCIAL WELFARE

Introduction
The volleyball is recognized as one of the most popular sports in the world. Not only volleyball players but the each sports players are training trunk muscle (Buckner et al., 2015). In volleyball match, each player functions have specific role, such as libero perform as the defensive specialist. There is the previous study that evaluated according to the position about volleyball competition (Marques et al., 2009; Paz et al., 2016).
Methods
Twenty Japanese university women's volleyball players (attackers [outside hitter, opposite, and middle blocker]: n=10, others [libero, setter, and defensive specialist]: n=10) performed the sit-up test with 45 degrees inclined, which comprised three sets interspersed with 30 seconds rest interval time (Kubo et al., 2006). Work volume was multiplied the number of times sit-up test and each body weight. Blood lactate threshold was measured before warming up and 1 minute later of the sit-up test using lactate pro 2. Data was analyzed with the independent t-test between attackers and other player's characteristics, and the two way (group, and time or sets) repeated measures ANOVA were used. Significance level was adopted as α=.05, β=.20, and more than large effect size of Cohen's accepted.
Results
Attackers was taller than other players, and no significant difference were found to exist between age and body weight. In both group, blood lactate threshold was increased more than before warming up by 3.0 times to 3.5 times, respectively. Moreover, the work volume was decreased (attackers: 28% the second set compared with the first set and decreased 53% the 3rd set, others: 37% the second set compared with the first set and decreased 63% the 3rd set), respectively.
Discussion
The sit-up test are not only the participation for the rectus abdominis muscles but also the influence by the quadriceps femoris muscle (Guimaraes et al., 1991). It was considered that the rectus abdominis muscles and the quadriceps femoris muscle are important to volleyball attackers than other position players. It is desirable to evaluate the sit-up test according to positions in volleyball players.
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Contact
yukowh@kyushu-ns.ac.jp

INFLUENCE OF CONSTANT KENDO PRACTICE FOR PHYSICAL FITNESS IN COLLEGE KENDO ATHLETES

HIRONO, J.1, KANDA, T.2, KAWABATA, D.3, TSUGA, Y.4, HAYAMI, T.1

1: SHINSHU UNIVERSITY (NAGANO, JAPAN), 2: CHUBU UNIVERSITY (AICHI, JAPAN), 3: SAPPORO CITY HIRAOKA MIDORI JUNIOR HIGH SCHOOL (HOKKAIDO, JAPAN), 4: TEIKYO HEISEI UNIVERSITY (TOKYO, JAPAN)

Introduction
Kendo is one of the Japanese traditional martial arts. We reported the relationship between physical fitness and kendo performance level in last year's this conference (Hirono et al., 2016). Kendo has a character of a lifelong sport, whereas it has a character of a competition sport. Sustained physical activity improves one's physical fitness level. However, few previous longitudinal studies reported influence of sustained kendo practice for physical fitness. The purpose of this study was to evaluate influence of kendo practice for physical fitness.
Methods
Nineteen male kendo athletes were participated in the experiment. Subjects participated physical fitness tests twice in the same year. Length of stride at front lunge was measured as the index of dynamic flexibility; vertical jump and medicine ball throw was measured as the index of power; 20-m sprints was measured as the index of sprint ability; pro-agility test (PA) was measured as the index of change of direction speed ability; hexagon agility test (HA) and edgren side step (ES) test was measured as the index of the ability of move quickly; yo-yo intermittent recovery test (IR) was measured as the index of endurance. The second (post) test was measured twenty weeks later. During a 20-week period, subjects practiced kendo more than twice a week except 5 weeks off-season. For the statistical analysis, paired t-test by means of comparison between pre-post tests. The statistical significance was set at $p < 0.05$ for all analyses.
Result
PA, HA, ES and IR showed significant superior values at post-test from pre-test ($p<0.05$). In the other physical fitness measurements showed no significant differences.
Discussion
In this study, the change of direction speed ability and the ability of move quickly, endurance significantly improved after 20 weeks kendo practice. The previous study reported that kendo practice significantly improved side step test value (Edo & Matsuda, 1984). During the course of the game, kendo athletes were required to response to various situations, to move quickly in various directions. Furthermore, the match time sometimes gets longer depending on the situation of the game; therefore, endurance is necessary to maintain performance and focus. In this study, subjects practiced kendo that aimed to win the competition. Therefore, it is thought that more direct abilities for game performance were improved.
Contact
hirono@shinshu-u.ac.jp

THE BUILDING OF AN AIDED CALIBRATION METHOD FOR ROUTINE SPORTS BIOCHEMISTRY BLOOD ANALYZERS

LI, P.F., FENG, B.X., ZHANG, W.Y., YANG, X.Y.

CHINA INSTITUTE OF SPORT SCIENCE

Introduction

It is important to remember that calibration method plays a vital role in the comparison of blood analysis system preformed on the same subjects between different detection instruments in the same laboratory. The aim of this study was to build an aided calibration method for routine hematology analyzers and biochemistry analyzers by fresh blood specimens from athletes.

Methods

1)Sample of fresh whole blood from athlete was measured in 2 hours by DIFF2 hematology analyzer, an reference instrument participating the EQA program, then used to calibrate GEN.S hematology analyzer. The RBC, HGB, HCT, MCV and PLT counting of 155 male athletes and 58 female athletes were compared between the two hematology analyzers on repeatability test, bias test and outlier test. 2)A pooled serum from balanced mix of ten athletes fresh serum was measured in 4 hours by 7020 biochemistry analyzer, an reference instrument participating the EQA program, then used to calibrate MD-100 biochemistry analyzer. The serum level of BUN & CK of 100 male athletes and 26 female athletes were compared between the two biochemistry analyzers on repeatability test, bias test and linearity range test.

Results

1)After the aided calibration for DIFF2 hematology analyzer, the repeatability test showed that the coefficients of variation (CV)% of five hematological parameters were 1.4, 0.6, 0.4, 0.6 and 2.3 ,beyond the degree of precision. The bias test showed that the bias value of five hematological parameters were respectively 0.4 minus, 0.5, 1.8, 0.7 minus and 4.1 minus in male group and 1.3, 0.8, 1.5, 0.8 minus, 4.2 minus in female group, lower than the maximum permissible error. The outlier test showed that there was no significant difference in abnormally low or high value of five hematological parameters between the two hematology analyzers. 2)After the aided calibration for MD-100 biochemistry analyzer, the repeatability test showed that the CV% of the serum level of BUN & CK were 0.92 and 1.22, beyond the degree of precision. The bias test showed that the bias value of the serum level of BUN was 0.2, and that of the serum level of CK was respectively 0.9 in male group and 3.5 in female group, lower than the maximum permissible error. The linearity range test showed that inflection point of the serum level of CK was 1000U/L.

Discussion

1)Application of athletes fresh whole blood for aided calibration of hematology analyzers is a reliable method.2)Application of athletes fresh pooled serum for aided calibration of biochemistry analyzers is a reliable method. It is proposed that the calibration method for hematology analyzers may be more helpful for the detecting athlete outliers in consideration of individual training background and that the calibration method for biochemistry analyzers can be more feasible to test the serum level of CK from athletes with sample dilution.

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Contact

lipengfei@ciss.cn.

FAST ISOINERTIAL KNEE EXTENSION TORQUE SHOWS GOOD RELATION TO SQUAT JUMP PERFORMANCE

DE RUITER, C.J., HARTVELD, T., PURMER, J.

AMSTERDAM MOVEMENT SCIENCES, VRIJE UNIVERSITEIT AMSTERDAM

Introduction

Jump height depends on power produced during push-off. Consequently, squat jump performance (SJ) is expected to be dependent on knee (and hip) extensor strength. However, relations between maximal voluntary isometric knee-extensor strength assessed with dynamometry and SJ often are weak. We expected that when tested under dynamic conditions, using isoinertial-mode, torque would be better related to squat jump height.

Methods

We tested healthy male subjects (n=14, 23±1.6 years) involved in different sports. Similar to our previous study, maximal isometric contractions (MVC) with and without superimposed doublet stimulation (femoral nerve 100Hz) and separate stimulated contractions (octet 300 Hz) were executed at 90° knee angle. In addition, fast isoinertial shortening contractions with constant low resistance (J=0.3 kg.m2) were done during relatively short (75-10°) and long (110-10°) knee extensions. All voluntary contractions were executed three times with 3 min rest in between. All torque measures were corrected for gravity. In addition, squat jumps from a 75° knee angle were executed. These were carefully controlled for joint position at the start and the absence of counter movements. The highest values of all variables (ranges) are reported and Pearson's r was calculated to establish significance ($p<0.05$) of relations.

Results

There were no significant relations between body mass (66-95 kg) and either any of the strength measures or SJ (all $r2 <0.17$). MVC (150-345 Nm), with voluntary activation between 87 and 99%, was related ($r2=0.56$) to SJ (32.3-44.6 cm). However, explained variance in SJ was higher for electrically evoked doublet ($r2=0.68$) and octet torque ($r2=0.71$). The highest explained variance ($r2=0.78$) in SJ was found for external torque (21-33 Nm) generated at the 65° (optimal) knee angle during voluntary short-ranged isoinertial contractions. During these contractions the attained velocities at the 65° knee angle ranged from 238-366 °/s, while peak velocities (533-733 °/s) were reached further into the knee extensions around the 30° knee angle. During the long-ranged isoinertial contractions, torque generated at the 65° knee angle (13-23 Nm) was also related to SJ ($r2=0.56$). However, the recorded surface EMG indicated that muscle activation was more variable among subjects during these long-ranged contractions, which may have reduced the strength of the relation between torque and SJ.

Discussion

All strength measures were significantly related to SJ height, but voluntary unilateral knee extension torque during short-ranged, low inertia shortening contractions, explained the highest proportion of variance in SJ.

Contact

c.j.de.ruiter@vu.nl

EFFECT OF OVERHEAD SQUAT TRAINING FOR 8 WEEKS POSTURAL CORRECTION ON BODY DEFORMATION CHANGE OF ELEMENTARY SCHOOL STUDENTS

GI DUCK, P., KANG SE, K.1, SEONG-DUEK, Y.2, DONGHUN, S.2
KYUNGPOOK NATIONAL UNIVERSITY, KEIMYUNG COLLEGE UNIV.

Introduction
This study aims to suggest more effective exercise method for spinal alignment correction by applying a squat and an overhead squat movement respectively for elementary school boys in grade 4 ~ 6 who have no special disease or surgery in spine and other musculoskeletal system and provide basic data to prevent diseases of the spine and musculoskeletal system due to the posture imbalance of the growing child.
Methods
In this study, two times of exercises a week for 8 weeks were implemented by selecting a total of 30 students, 10 students of squat group, 10 students of overhead squat group and 10 students of control group from 30 male students in grade 4 to 6 in an elementary school located in Gyeongsangbuk-do, in order to investigate the effect of overhead squat exercise on body shape change of elementary school students. When it comes to the data processing, two-way ANOVA repeated measurements was performed for average difference verification by group and time before and after exercise by using the SPSS program and the paired t-test was implemented for the interaction effect analysis and the significance level was set to .05.
Results
First, shoulder height and pelvic height from the front view did not show statistically significant difference in both squat and overhead squat groups between before and after exercise in both groups($p>.05$). Second, the cervical angle from the side view did not show a statistically significant difference in the squat group($p>.05$), and the overhead squat group showed a statistically significant difference after exercise($p<.001$). Third, pelvic angle from the side view did not show a statistically significant difference between before and after exercise in both squat and overhead squat groups($p>.05$). Fourth, there was no statistically significant difference found in scapula height from the back side view($p>.05$) in the squat group, but there was a statistically significant difference found in the overhead squat group($p<.05$).
Discussion
It is considered that this study helps better understand what kind of positive effects the overhead squat exercise will bring in children's body shape change and it can be provided as a basic data for the development of a body correction exercise program for growing children.

A HOPPING EXERCISE INTERVENTION IMPROVES POSTURAL STABILITY IN OLDER ADULTS: A RANDOMIZED CONTROLLED TRIAL

NAKATANI, T., OKADA, O., YAMAMOTO, H., TERADA, K., SHIRAISHI, A., NADAMOTO, M.
HUMAN PERFORMANCE LABORATORY

Introduction
Aging and physical inactivity are associated with an increased risk of falling (Campbell et al., 1989). Physical activity may modulate postural control in older adults (Barnett et al., 2003; Skelton, 2001). Therefore, the aim of this study was to investigate the effects of hopping exercise (HE) training on postural stability in healthy older adults.
Methods
Twenty-six healthy men and women aged 65 to 83 years participated in this study. Participants were randomly assigned to either a hopping exercise (HE, n = 13) or balance exercise (BE, n = 13) group. The HE group performed two sets of two-legged hops at a frequency of 1.5Hz until they reached a moderate level of perceived exertion (Borg rating of 15). The BE group exercised on a foam stability pad or narrow balance beam. Both groups trained twice per week for 12 weeks and participated in 60-min supervised group exercise sessions held once every 2 weeks at a local center. Center of pressure (CoP) measurements were used to evaluate postural stability. The following parameters were assessed: sway path length (LNG), enveloped area (EA), sway path length per unit of time (LNG/T), locus length per unit area (LNG/EA), and mean position of X-axis (ML) and Y-axis (AP) sway. Tests were performed while participants stood quietly for two 30-sec periods (with eyes open and eyes closed) in a narrow stance.
Results
Repeated measures analysis of variance showed a significant effect of the interaction between exercise and time on LNG/EA with eyes closed, and a significant main effect of time of measurement on LNG, EA, LNG/T, and AP direction with eyes open and the AP direction with eyes closed. Postural sway in the HE group was significantly reduced after the 12-week intervention. The CoP with eyes open shifted posteriorly in both groups after the intervention.
Discussion
Postural stability in healthy older adults was improved more by two-legged hopping exercise than by balance exercise. These beneficial changes in postural stability may contribute to increased postural control during daily activities and to reduced fall risk (Park et al., 2012).
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Contact
toshiaki@sta.tenri-u.ac.jp

APPLICATION OF VT AND RCP IN MONITORING OF GAME INTENSITY DURING POLISH VOLLEYBALL NATIONAL TEAM COMPETITION

GABRYS, T.1, STANULA, A.2, SZMATLAN-GABRYS, U.3

UNIVERSITY JAN DLUGOSZ CZESTOCHOWA, 2 THE JERZY KUKUCZKA UNIVERSITY OF PHYSICAL EDUCATION. 3 UNIVESRSITY PHYSICAL EDUCATION IN KRAKOW

Introduction
It is commonly thought that the level of players' fitness can be maintained or improved only when training loads and methods are selected in such a way as to activate game-specific muscle groups and energy systems [Gonzalez-Rave et al. 2011]. What follows from the observation is that a prerequisite to programming a training process is the availability of a quick, simple and most of all reliable analysis of the actual impacts of training and game demands on athletes [Sheppard et al. 2007]. The purpose of this study was the evaluation of volleyball game intensity.
Methods
In this study 8 players were included, age: 19.0±0.54, height: 199.8±8.88 cm and weight: 93.4±12.41 kg, VO2max 54.1±6.35 ml/kg/min, HRmax 197±12.2 b/min, VT 147±12.9 b/min, RCP 172±14.3 b/min. Intensity was recorded during competition against Brazil National Team using Polar Team 2 System (Polar electro OY, Kempele, Finland). Testing was performed with progressive running test at 40m distance, speed increasing from 8km/h every 2 minutes by 1.5 km/h until exhaustion. Exhaled air was continuously sampled by an K4b2 (Cosmed, Italy) and the rate of VO2, VCO2, VE were calculated every 5 seconds by an on-line computer system. Threshold values VT and RCP were calculated according to procedures described by [Chicharro et al. 2000].
Results
Most of game intensity (73.3%) is classified as low intensity. Approx 25% game was classified and moderate intensity. Only 2.75% of competition time was in high intensity zone.
Discussion
Volleyball is an intermittent sport that requires players to compete in frequent short bouts of high- intensity exercise, followed by periods of low- intensity activity [Gonzalez-Rave et al. 2011, Polgaze et al. 1992]. Presented method of training load assessment allows quantifying cardio-vascular load of players during training. However as results showed, this method can not be used for evaluation of comprehensive load during volleyball game. Most of load in volleyball is based on alactic resources (ATP–PCr). This type of load can not be evaluated with only cardiovascular parameters of load. During high-intensity bouts of activity on the court, while players are involved in intense jumping activities where power, strength, agility, and speed are required other methods can be more appropriate to monitor loads.
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Contact
tomaszek1960@tlen.pl

INTERNAL LOAD CHANGES IN RESPONSE TO EXTERNAL LOAD CHANGES DURING EFFORT IN CONDITIONS OF NORMOXIA, AND HIGH-ALTITUDE HYPOXIA IN ALPINE SKIERS

SZMATLAN-GABRYS, U.1, GABRYS, T.1, STANULA, A.2

1DEPARTMENT ANATHOMY UNIVERSITY PHYSICAL EDUCATION IN KRAKOW, POLAND 2UNIVERSITY JAN DLUGOSZ CZESTOCHOWA, 3THE JERZY KUKUCZKA UNIVERSITY OF PHYSICAL EDUCATION, KATOWICE, POLAND

Introduction
The effort of an alpine skier, characterized by maximum, or submaximal intensity, depending on the sporting event, lasts from 30, to 120s (Vogt et al. 2005). Determining the ranges of changes in the course of the relationships between external, and internal loads observed in conditions of normoxia, and high-altitude hypoxia lets us optimize training loads in this sports discipline. The aim of this study, was to evaluate the bodily response of the alpine skier internal load (LA) to external load changes (the workout performed) during the effort of gradually increasing intensity.
Methods
The participants were the members of The Polish National Alpine Ski Team (n=11, 22±2 years old). Everyone examined carried on cyckloergometer a test GTX (Graded Exercise Test). The study was carried out at the following altitudes: 260 MAMSL (Warsaw), 1450 MAMSL (Hintertux Dorf), 3250 MAMSL - The Hintertux Glacier. The workout (W, J/kg; P, W/kg b.w.) and lactate concentration in the blood (LA, mmol/l) were registered.
Results
The value of internal load (I), regardless of the altitude, was constant. The value which changed, was that of high-altitude hypoxia. LA was an internal load marker. Up to the level of 3W/kg no results, the participants carried out the assigned workout. Above this force, high – altitude hypoxia influenced the ability to continue the effort. The participants ended their effort, when the force reached 4.5W/kg b.w.(230 MAMSL), 4 W/kg b.w. (1450 MAMSL), 3.5W/kg b.w (3200 MAMSL). In the image of the internal load (LA), changes in the conditions of high-altitude hypoxia occurred from 2W/kg b.w. LAmax values change from 14, 4 ±1,3 through 12, 6 ±1,1 to 10,8 ±1,6 mmol/l (altitude: 230–1450-3200 MAMSL)
Discussion
A 1200-1400 MAMSL increase in altitude, results in decreasing the maximum external load by 0.5 I/kg b.w., decreasing the maximum anaerobic metabolism mobilization, in the effort energy production, above the load of 3 I/kg b.w. Regression equations were determined for the changes in LAmax in comparison with the value registered in normoxic conditions: for the altitude of 1450 MAMSL (y=0.7884x + 0.6753), and 3250 MAMSL (y=0,6988x – 0.4489), and I max for the altitude of 1450 MAMSL (y=0.9747x – 639.17) and for the altitude of 3250 MAMSL (y= 0.4458x + 677.56).
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NORMALIZING VO2MAX TO BODY COMPOSITION: GENDER DIFFERENCES IN HIGHLY TRAINED ENDURANCE ATHLETES

KANTANISTA, A., KORMAN, P., ZIELIŃSKI, J., OLEJNIK, M., KUSY, K.
POZNAN UNIVERSITY OF PHYSICAL EDUCATION

Introduction
Maximal oxygen uptake (VO2max) is currently the most used measure of aerobic capacity (Gonzalez-Parra et al., 2013). Normalizing VO2max by body mass is usually used, but it does not explain gender differences. Therefore, the aim of the study was to evaluate differences between male and female endurance athletes in VO2max in relation to body mass (BM), lean body mass (LBM) and skeletal muscle mass (MM).
Methods
The sample consisted of twenty six endurance runners (long distance athletes, n = 6; orienteering athletes, n = 3; triathlon athletes, n = 17) members of the Polish national team. Seven women (age = 24.0 ± 6.0; body height = 169.6 ± 3.3 cm; BM = 58.0 ± 4.5) and nineteen men (age = 22.7 ± 4.3; body height = 181.8 ± 6.2 cm; BM = 71.7 ± 6.9) took part in the study. Body composition was determined by dual energy X-ray absorptiometry (GP HealthCare Lunar Prodigy). SM was estimated using equation proposed by Kim et al. (2002). VO2max was measured during incremental running treadmill test (Pulsar, h/p/cosmos, Germany) until exhaustion by means of the MetaMax 3B-R2 ergospirometer and the MetaSoft Studio software (Cortex Biophysic, Germany).
Results
Female athletes had lower LBM (76.7% vs 82.5%, $p < 0.001$), MM (40.2% vs 44.7%, $p < 0.001$), and higher body fat mass (FM) (19.0% vs 13.2%, $p < 0.001$), compared to male athletes. BM was lower in women than in men ($p < 0.001$). The differences were observed between women and men in aerobic capacity when VO2max were expressed in absolute values (3438±473 ml/min vs 4808±484 ml/min, respectively, $p < 0.001$) or relative to BM (59.3±6.0 ml/min/kg BM vs 67.1±3.9 ml/min/kg BM, respectively, $p < 0.001$) but there were no differences when VO2max was expressed relative to LBM (77.3±5.8 ml/min/kg LBM vs 81.4±4.9 ml/min/kg LBM, respectively, $p = 0.081$) and relative to MM (147.8±14.1 ml/min/kg MM vs 150.4±11.6 ml/min/kg MM, respectively, $p = 0.602$).
Discussion
The differences in VO2max between male and female endurance athletes are not significant when normalized by LBM and MM. These results support the need for normalizing maximal aerobic capacity in terms of LBM or MM rather than by BM to compare the levels of muscle aerobic potential in endurance athletes. It seems that skeletal muscle of male and female athletes are similarly efficient as regards aerobic capacity.
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Contact
adam.kantanista@gmail.com

GAIN IN PERFORMANCE PARAMETERS BUT NOT IN AEROBIC CAPACITY BY HIGH INTENSITY INTERVAL TRAINING IN YOUNG WOMEN

SELLERBERG, M., SCHEER, V., HEITKAMP, H.C.
UNIVERSITY PADERBORN

Introduction
Due to an increasing number of positive results, high-intensity interval training (HIIT) gains more popularity. Fitness and power, also running performance are increased, also partly by a rise in aerobic capacity in young women.
Methods
A structured supervised 8-week HIIT programme (10 minutes warm up followed by five 30 seconds all out sprint intervals with 2 minutes rest period between intervals) was performed twice weekly. Pre and post training intervention a standardised spiroergometry test with lactate diagnostic on a treadmill (step test protocol) was performed to measure VO2max, maximum running speed, maximum lactate, speed at the anaerobic threshold and the100 m sprint performance.
Results
Originally 21 women agreed in the training programme (21-29 years). Two dropped out because of muscle pain after a few training units. Before and after the training period the parameters were: VO2max (37.9± 3.5 ml*kg -1*min -1 vs 37.5±1.6 ml*kg -1*min -1, n.s.), maximum speed (13.0±1.3 and 13.7±1.3 km/h, $p < 0.001$), maximum lactate (9.58±2.1 and 9.78±1.6 mmol/l n.s.), speed at the individual anaerobic threshold (9.61± 1.26 and 9.98±1.03 km/h, $p <0.01$), 100 m sprint time (17±2.2 sec vs 15.8±1.2 s, $p <001$). Heart at rest dropped from 73± 11 to 69± 12/min, n.s.). The adherence to the training programme was 86%. From originally 11 women in the control group, only seven came for control to the laboratory. In the control group no significant changes were observed in any of the parameters.
Discussion
HIIT should be recommended for young women for a gain in fitness, though a gain in aerobic capacity was missing. The higher speed at the anaerobic threshold must be due to coordination gain rather than a gain in aerobic capacity. Also, the higher maximum speed is attributed to a gain in coordination rather than a gain in aerobic or anaerobic capacity.

DEVELOPMENT OF VIRTUAL REALITY COGNITIVE PERFORMANCE TEST FOR SOCCER REFEREES AND ITS RELATIONSHIP WITH CONCENTRATION GRID-EXERCISE TEST

YAMAUCHI, H., SHIMIZU, Y., OHTA, K.
INTERNATIONAL CHRISTIAN UNIVERSITY

Introduction
In sports referee's decisions are occasionally discussed and spotlighted by media. Soccer is not an exception and there are many cases that controversial decisions affected the results of the matches. Needless to say, correct decision-making requires high-level of cognitive abilities. However, only a few researches on cognitive assessment or training in soccer refereeing have been reported and virtual reality

(VR) technology has not been adopted for testing neither. Therefore, this study were aimed to develop the virtual reality cognitive performance test specified for soccer referees (VRef) using Sony PlayStation VR and to seek the relationship with concentration grid-exercise test (CGet).
Methods
The subjects were 18 active soccer referees (mean age = 20.5 years, s = 1.1, mean refereeing experience = 5 years, s = 2.1) who are registered to Japan Football Association and trained in Japan University Football Association Kanto Elite Referee Course. First, they performed the CGet that impose a 3-time task to circle numbers in order from 1 to 50 as fast as possible in a period of 1 minute and counted the numbers circled as score. Second, they experienced the VRef that consists of 10 ball-out-of-play (BOP) clips answered with colour + number of last-touched player, and 10 offside situation (OFF) clips answered with "offside" or "not-offside", both recorded by 180-degree camera on actual soccer field.
Results
The mean scores in VRef were 5.1 (s = 1.5, BOP), 7.1 (s = 1.5, OFF) and 12.1 (s = 2.2, BOP+OFF). The mean scores in CGet were 29.3 (s =6.3, 1st), 30.1 (s = 8.5, 2nd), 27.3 (s = 7.9, 3rd) and 86.8 (s = 19.1, 1st+2nd+3rd). Multiple regression analysis between total score of VRef and 1st score of CGet demonstrated that multiple coefficient of determination ($R2=0.220$, $p<0.05$) and standard partial regression coefficient ($\beta=-0.470$, $p<0.05$) were statistically significant.
Discussion
The result of the analysis showed that the higher scores in CGet is associated with the lower scores in VRef. It means that soccer referees, who highly concentrate on only one task, tend to be unable to recognise a ball and multiple players wholly at the same time. Thus, the findings of this study indicated that focusing only one object could give a negative effect on decision making of soccer referees.
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EFFECT OF ACUTE STATIC STRETCHING ON VERTICAL JUMP PERFORMANCE IN TRAINED CHILDREN

DONTI, O., PAPIA, K., PAPIA, A., PANIDIS, I., DONTI, A., TOUBEKIS, A., BOGDANIS, G.C.
NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

Introduction
A number of previous studies indicated that prolonged, acute static muscle stretching reduces vertical jump performance in adults (Kay and Blazevich, 2012). However, research is limited on stretch-induced muscle performance decrements in children. The aim of this study was to examine changes in one-leg counter movement jump (CMJ) height after an acute bout of static stretching in preadolescent gymnasts.
Methods
Nineteen female gymnasts (age: 9.8±0.5 years, training experience: 2.5±1.5 years, height: 135.0±7.3cm, body mass: 33.4±6.9 kg) performed 90 s of continuous static stretching of the quadriceps muscle from a supine position. A single-leg stretching and jumping design was used, with the contra-lateral limb serving as a control. One leg CMJ height was measured for the stretched and the control leg, before and 2 min after stretching. Acute changes in CMJ height (pre- and post-stretching) were examined using a 2-way ANOVA with repeated measures on both factors (leg x pre-post). Effect size for pairwise comparisons was determined by calculating Cohen's d.
Results
One-leg CMJ height remained unchanged post stretch for the stretched (pre: 7.4±1.7, post: 6.9±1.8 cm), and the control leg (pre: 7.0±1.7, post: to 6.7±2.1 cm) as shown by the lack of main effects ($p= 0.207$ and $p= 0.278$, for pre-post stretch and leg, respectively) and interaction ($p= 0.444$). Effect sizes for the pairwise comparisons of the one-leg CMJ height before and after stretching for each leg, were also small ($d<0.3$).
Discussion
The results of this study indicated that one-leg CMJ height of the stretched leg was not reduced 2 min after an acute bout of 90 s of static stretching, a finding supported by some recent studies in adults (Kallerud and Gleeson, 2013). Furthermore the effect size for the stretched leg was small ($d=0.3$) indicating that the negative effect of static stretching on jumping performance is limited in practice. The lack of stretch-induced jumping decrements may be explained by the fact that the young gymnasts in this study regularly applied stretching protocols of this duration during training. In addition, preadolescent children may be less susceptible to stretch-induced muscle power loss than adults due to the increased pliability of muscle tissue during childhood. Future studies should examine the neuromuscular mechanisms underlying children' s response to different stretching protocols.
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THE PHYSICAL STRENGTH CHARACTERISTICS OF SPECIFIC POWER TESTS IN COLLEGE MEN'S TENNIS PLAYER

SUZUKAWA, K.1, KAWAKAMI, R.1, MIYACHI, K.2, UMEBAYASHI, K.1,2
OSAKA UNIVERSITY OF HEALTH AND SPORTS SCIENCES

Introduction
Physical strength characteristics are important to know an athlete's physical fitness in tennis. Fitness test in tennis has been changing ideal tests and equipment that developed the fitness tests feedback to an athlete. The recent study shows that Banyard et al. (2017) research measured mechanical variables in back squat by using power measurement hardware. The research needs to verify physical strength characteristic in power output among measurement items. Purpose: The purpose of study was to clarify the physical strength characteristic of specific power tests in tennis player.
Methods
Participants: College men's tennis player (n=12) were randomized in this study. Experimental Design: The participants conducted three types of medicine ball throw (Overhand, Forehand, and Backhand), the standing long jump, and the standing triple jump. Statistics: Standard statistical methods were used for the calculation of means ± SD. The variable of medicine ball throw was analyzed by one-way ANOVA (condition and mechanics variable). A significant difference was found for main effect, a Bonferroni post hoc test was performed.

Pearson correlation coefficients were used to examine the relations between peak power and the standing jump, and peak power and the standing triple jump. Statistical significance was set at $p < 0.05$.
Results
There were significant differences in peak force (Fore vs Over, Back vs Over) and peak power (Fore vs Over) in medicine ball throw. There was negatively correlated between the standing jump and overhead throw (peak power).
Discussion
The hitting movement in tennis is used trunk rotation. This factor may be related to differ power output between over vs. fore and over vs. backhand in tennis player. However, this study was limited to examine the power tests with tennis performance. Therefore, the study suggests that medicine ball throw may be efficient and ideal fitness test for tennis player.
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Contact
Email: 216m13@ouhs.ac.jp

CHANGES IN BODY SURFACE TEMPERATURE DURING INCEMENTAL TREADMILL TEST IN HIGHLY-TRAINED ATHLETES OF DIFFERENT SPORTS

KORMAN, P., KUSY, K., KANTANISTA, A., STRABURZYNSKA-LUPA, A., ZIELINSKI, J.
POZNAN UNIVERSITY OF PHYSICAL EDUCATION

Introduction
The mechanism of thermoregulatory adaptation to exercise cannot yet be fully explained, however, infrared thermography seems to have potential for monitoring physiological changes during exercise and training (Korman et al. 2016). The thermoregulatory process and infrared radiation can differ depending on sport discipline (Arfaoui et al. 2012).
Therefore, the aim of this study was to compare thermoregulation patterns during incremental treadmill exercise test and recovery in highly trained athletes of different sport disciplines.
Methods
Seventy eight participants aged 24±4 years were evaluated: sprinters (LS, n=12), long distance runners (LD, n=9), triathletes (RO, n=14), taekwondo athletes (TK, n=18), futsal players (FU, n=13) and healthy control participants (CO, n=12). They underwent a treadmill test until exhaustion. Lower limb surface temperature was measured and thermal images were taken using infrared camera during the test and 30- minute recovery period.
Results
In all participants, excluding the CO group (31,8±1,5 vs 30,4±1,8°C p=0,1) the treadmill test induced a significant decline in surface temperature from baseline temperature (LS 32,3±06 vs 31,5±08 p=0,047; LD 30,9±09 vs 29,9±0,9 p=0,005; RO 31,5±0,6 vs 29,8±1 p=0,000 ; TK 31,2±1,2 vs 29,8±1,5 p=0,000 ; FU 31,6±0,8 vs 29,9±1,1°C p=0,000). In all groups the temperature returned to the pre-test (baseline) level until the end of the recovery period. The temperature changes between groups during test and recovery were insignificant despite distinct sport discipline characteristics.
Discussion
The time course of surface temperature during physical effort and recovery was not different between distinct athletic groups. Nevertheless the lack of temperature decline in CO group may suggest specific thermoregulatory adaptation in highly trained athletes.
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Contact
pkorman@awf.poznan.pl

THE INFLUENCE OF PHYSICAL EXERCISE ON FLOW-EXPERIENCE IN A SUBSEQUENT COGNITIVE TASK - A PILOT STUDY

STALLMANN, C., HEIN, N., SCHNEIDER, C., PEIFER, C., FERRAUTI, A.
RUHR-UNIVERSITÄT BOCHUM

Introduction
Flow-experience is often described as an 'optimal feeling' which consists of these five elements: modified perception of time, deep concentration on activity, strong feeling of control, deep involvement in activity, and high feeling of intrinsic motivation. Recent studies show an inverted U-shape relation between flow and physiological arousal [Peifer et al. 2014]. Aim of this study was to analyse whether an indication for a spill-over effect of exercise on flow-experience in a following task exists, hence if running should be done before an important cognitive challenge.
Methods
Three female students (age 25 yrs, height 176±4 cm, weight 67.4±4.4 kg, VO2max 44.8±8.3 ml/min/kg) underwent an incremental treadmill test (VO2max, lactate-profile) and three intervention days (1-week apart) in a cross-over design. On each day of testing a cognitive task (CT), one of the three exercise interventions, and another CT were completed. Exercise intensities [Pescatello et al. 2014] were low (W: walking, RPE-scale: <9), moderate (J: jogging, RPE: 12-13), and high (R: intensive running, RPE: 14-17). CT consisted of arithmetical problems on the computer (addition of 4-digit on double-digit numbers) for 5 min. Flow-experience during CT and exercise was measured using the flow short scale (FKS, [Rheinberg et al. 2003]). Heart rate (HR) was recorded during the entire sessions.
Results
Exercise-HR was different between intensities (W: 93±5 bpm, J: 155±9 bpm, R: 175±7 bpm). HR during CT pre and post intervention show a decrease for W (-3%) and an increase for J (+20%) and R (+30%). Flow-experience differ widely between subjects and the CT-performance displays strong familiarization effects. Single-case analysis of subject 2 showed a spill-over effect for all interventions in an

inverted-U-shaped relation between flow and exercise intensity. Furthermore a high correlation (r=.94) between flow and the performance variability during CT (coefficient of variation of response time) was observed.
Discussion
Exercise may impact the flow-experience of a subsequent cognitive task. However, a distinctive consideration of the individual is necessary. The findings suggest either the further requirement of familiarization with the cognitive task on each testing day or a control group. A planned future study must confirm the spill-over effect observed in the individual case and assess the effect of exercise intensity and individual variability. A closer look on physiological arousal (i.e. heart rate variability) may also be valuable.
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Contact
carolin.stallmann@rub.de

LOAD ADJUSTMENT FOR WEIGHTED VEST RESISTED SPRINT TRAINING IN SEMIPROFESSIONAL SOCCER PLAYERS

CARLOS-VIVAS, J., FREITAS, T.T., MARÍN-CASCALES, E., CUESTA, M., TOSCANO, F.J., CASTILLO, A., DE HOYO, M., ALCARAZ, P.E.

CATHOLIC UNIVERSITY OF MURCIA; UNIVERSITY OF SEVILLA

Introduction
Sprinting is a key factor in soccer performance. Resisted training is a common training method used in team sports (sled towing, weighted vest (WV), parachute...) (1) which allows reproducing the technical gesture of competition with an additional external load added (2). Therefore, the aim of the study was to develop a regression equation that accurately describes the relationship between WV loads and the resulting sprint velocity in the acceleration phase.
Methods
A regression analysis was performed to develop an equation to establish the optimal training load (OL) for sprinting. Twenty five semiprofessional soccer players (1.79±0.05 m, 72.21±6.66 kg) performed 8 20-m maximum sprints with four different loads (2 unloaded; 2 using a WV of 5%, 10% and 15% body mass (BM)). Trials' order was randomly assigned for each participant and separated by a 5-min rest. The maximum velocity (Vmax) was measured with a radar gun (Stalker ATS II; 47Hz) and the best time trial for each load was selected for analysis.
Results
All sprint velocities were converted to percentage of Vmax over 20 m. These data were plotted against each other producing the following equation: %BM = -1.5803 x % Velocity + 160.11. The R value was 0.87. This value reflected a good significant linear relationship ($p \leq 0.001$).
Discussion
The equation obtained could be used to control workload of soccer players in sprint exercises and to quantify the OL from the BM of each athlete. In our study, 18% BM corresponded to the OL, following previous recommendations that the decrease in Vmax should not be higher than 10% to maintain load specificity in sprints (Lockie et al. 2003). Lockie et al. (2003) suggested that OL was closer to 12.5% BM, and Alcaraz et al. (2009) indicated that the greater load should be near 10% BM. The gradient of our equation was more pronounced than the equation proposed by Alcaraz et al. (2009) and less than the other proposed by Lockie et al. (2003). A higher gradient means a minor decrease in running velocity when the load increased, and thus, a better sprint performance.
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Contact
jcarlos@ucam.edu

THE EFFECT OF STATIC PASIVE STRETCHING ON REDUCTION OF GLENOHUMERAL INTERNAL ROTATION DEFICIT

SOLANA-TRAMUNT, M., MORALES, J., BUSCÀ, B., AGUILERA, J., BLANCO, S.

FPCEE BLANQUERNA, UNIVERSITY RAMON LLULL

Introduction
Shoulder injury is a common problem of overhead athletes. When the amount of IR or total arc of motion difference reaches a certain threshold (typically 20 or more degrees of IR or 8 degrees of the total arc difference), it is known as glenohumeral internal rotation deficit or total arc of motion deficit. Glenohumeral internal rotation deficit and total arc of motion deficit can cause alterations in biomechanics such as scapular "wind-up" or alteration of glenohumeral joint kinematics, which can in turn lead to clinical findings of impingement and labral pathology, so common in swimmers (Kliber, 2012). Moreover, it's reported a reduction of side-to-side glenohumeral rotation from 11 to 18 degrees can increase 1.9 points the injury risk. Professional swimmers not only perform more than 30km per week, but use some competitions as a training session. To our knowledge, it isn't known how competition can affect to glenohumeral rotation range of movement and how a simple static passive stretch could reduce this restriction. Therefore, the aim of this study was to determine whether a static passive stretch could improve the glenohumeral internal rotation after competition in professional swimmers.
Methods
Participants: A total of 35 professional swimmers aged from 16-33 years volunteered to participated in the study. Their competition experience were more than 2 years at national level. The exclusion criteria include to have pain in the shoulder the last week. All the subjects were informed in written and verbal form and signed their informed consent before being assessed. A repeated measures randomized clinical trial design was used to assess the glenohumeral rotation in 3 moments: prior to the race, just after finishing their trial and after performing a static passive stretch of posterior deltoid muscles of 90-sec. In randomized order the computer select 10 subjects as a

control group who didn't perform the stretching. The glenohumeral rotation degrees were assessed by a video camera (IPhone 6S, version 10.1), attached to a tripod, in sagittal plane, with the center of the screen at shoulder high. Subjects were laying on supine position over a massage table, with the glenohumeral joint at 90 of abduction and the physiotherapist controlling the scapula movements by pushing the shoulder over coracoid apophasis. The App Thechnique (Ubersense ,) was used to analyze the videos and to measure the rotation angles between the vertical line (controlled by a plumb) and the forearm segment.
Results
Pairwise comparisons showed that there was a significant differences on Internal rotation and total arc of movement in the experimental group performing the stretching respect the control group $F(2,48)=49.151$, $P<0.05$, $2p=0.627$.
Discussion
To apply a static passive stretching of posterior deltoid during 90-sec increase the internal rotation deficit after a competition in professional swimmers.

COMPARISON OF DIFFERENT TYPES OF JUMP ABILITY IN BASKETBALL PLAYERS

KOYAMA, T.1, RIKUKAWA, A.2
1,2:TOKAI UNIVERSITY

Introduction
Previous research reported that the mechanisms of the nervous system, muscular system and tendon system were different between counter movement jump and rebound jump (Desmedt et al. 1977, Zushi et al. 1995). Those different jump abilities were necessary in ball sports. The purpose of this study was to investigate two different jump abilities between the positions (guard, forward, and center) in basketball.
Methods
Participants were 101 male basketball players (guard: 45, forward: 44, center: 12) who belonged to the Division 1 Kanto Collegiate Basketball League in Japan. The participants executed counter movement jump (CMJ) as long contact time jump, and 5 rebounds jump (5RJ) as short contact time and ballistic movement. To evaluate those jump abilities, jump height was measured for CMJ, while RJ-index was employed to measure 5RJ. The RJ-index was calculated by dividing the jump height by contact time. One-way analysis of variance (ANOVA) was used to compare performance in each test by different positions.
Results
There was no statistical significance between positions in CMJ ($p = 0.58$) (guard: 65.5±8.6cm, forward: 64.5±10.4cm, center: 62.4±9.4cm). However, RJ-index was significant difference between positions ($p < 0.01$). Moreover, post-hoc test analysis (Tukey test) revealed the significant difference between center players and guard players ($p < 0.05$) or forward players ($p < 0.01$) (guard: 2.32±0.48, forward: 2.19±0.36, center: 1.84±0.48).
Discussion
The RJ-index of center players was significantly lower than forward and guard players. In other words, it was assumed that ballistic ability of the center players was lower than the other position. This finding was likely associated with the difference of body size, body composition and players' position. The center players have characteristics of tall height, heavy weight and many jumps in the game. Therefore, it may be necessary that jump training should tailor depending on the position.
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Contact
koyama@tokai-u.jp

EFFECTS OF KNEE ANGLE ON PEAK FORCE AND FATIGUE DURING MAXIMAL ISOMETRIC SQUATS

BOGDANIS, G.C., TSOUKOS, A., VELIGEKAS, P., TERZIS, G.
NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS

Introduction
Maximal isometric muscle actions are commonly used to induce postactivation potentiation (PAP) of the lower limbs (Tillin & Bishop, 2009). However, little is known regarding the effects of muscle length on PAP, and there is evidence suggesting that subsequent muscle performance is a balance between muscle activation and fatigue (Hamada et al., 2003). The purpose of the present study was to examine the effect of knee angle on peak force and fatigue during maximal isometric squats.
Methods
Ten track and field power athletes (age: 28.3±7.8 yrs, height: 177±10 cm, body mass: 76.3±7.5 kg) with a training experience of 10.3±7.4 years took part in the study. Countermovement jump (CMJ) performance was assessed using Optojump and peak ground reaction force was measured (1000 Hz) during isometric squats in a power rack at 6 different knee angles (67o-143o. In separate sessions, a 15 s maximal isometric fatigue test was performed at two different knee angles that are commonly used by coaches in sports training (90o or 140o). Fatigue was calculated as the slope of the isometric force decrease during the 15 s test, by linear regression. Data were analyzed using one- or 2-way ANOVA with repeated measures and Tukey post-hoc test.
Results
Peak isometric force increased with knee angle (main effect of knee angle, $p=0.001$), with the peak value attained at the largest knee angle (3831±584 N at 143±3o). This value was 2-fold higher than that attained at the smallest knee angle (1909±243 N at 67±8o). Fatigue during the maximal isometric test was evident only when knee angle was 90o (force drop at the end of the 15 s test= -19.1% compared to peak; slope=-23.6 N/s). In contrast, there was no fatigue when knee angle was 140o (force at the end of the 15 s test= +1.1% compared to peak; slope=+2.3 N/s), despite the fact that peak isometric force was twice as high at 140o compared to 90o. Peak isometric force and CMJ height were correlated with fatigue only at the knee angle of 90o ($r=0.64$ and $r=0.74$, $p<0.05$), but not for the 140o ($r=0.15$ and 0.25, n.s.).
Discussion
Muscle fatigue during maximal isometric squats was observed only when the main leg extensor muscles operated at longer length (90 vs. 140o), despite the fact that peak isometric force was 2-fold higher. The fact that peak isometric force and CMJ height were correlated

with fatigue only at the knee angle of 90o, would indirectly suggest that individuals with high muscle strength and power may fatigue more at this squat position, possibly due to their high percentage of fast twitch fibers (Hamada et al., 2003). Thus, maximal squats at this angle should be avoided by strong and powerful individuals when the aim is short-term muscle potentiation.

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Contact
gbogdanis@phed.uoa.gr

RELATIONSHIP BETWEEN AEROBIC FITNESS AND RSA TEST PARAMETERS IN ELITE MALE BASKETBALL PLAYERS

STANULA, A.1, MIKOŁAJEC, K.1, GABRYS, T.2

1: AWF (KATOWICE, POLAND), 2: SSHE (OŚWIĘCIM, POLAND)

Introduction
Basketball is characterized by intermittent activity ranging from short bursts of high intensity to longer periods of moderate intensity and recovery [McInnes et al. 1995]). High aerobic fitness is an important feature to improve basketball performance [Abdelkrim et al. 2007], for example, enhancing the ability to recover from the anaerobic efforts during a game [Stone et al. 2009], to reiterate sprints or high-intensity accelerations with short recovery intervals [Spencer et al. 2005], and to prepare players to sustain an appropriate training load volume. The primary objective of this study was to determine a relationship between aerobic capacity (VO2max) and fatigue from high-intensity running in elite male basketball players.
Methods
43 elite male basketball players, members of the Polish National Teams participated in the study (U16, n=13; U18, n=16; U20, n=14). Each subject completed an repeated sprint ability (RSA) test consisting of 6 timed 30-m sprints, with 10 s of rest between subsequent efforts (photocells made by Microgate (Bolzano, Italy) recorded the times of each sprint with accuracy of 0.01 s), and a progressive running test at 40 m distance (speed increasing from 8 km/h every 2 minutes by 1.5 km/h) until exhaustion (exhaled air was continuously sampled by an K4b2 (Cosmed, Italy)) and the rate of VO2, VCO2, VE were calculated every 5 seconds by an on-line computer system. Sum of time 6 repetitions (Σ6R), difference between 1 and 6 repetition (DIFF 1-6) as well as fatigue index (FI=((the fastest run time – the slowest run time)/the fastest run time) x 100) from RSA test was calculated [Oliver et al. 2009].
Results
The mean values (±SD) in terms of Σ6R, DIFF 1-6 and FI variables equalled respectively, U16: 27.98±1.05, 0.54±0.16, 12.21±3.69; U18: 27.69±1.26, 0.6±0.11, 13.94±2.54 and U20: 27.93±1.16, 0.56±0.16, 12.69±3.4. No significant correlation were recorded between VO2max value and RSA test parameters.
Discussion
Lack of relationship between VO2max level and RSA test results observed in this study seem to indicate that running distance and number of repetitions characteristic for RSA test was no sufficient to apply the process of re-synthesis of ATP under aerobic conditions [Spencer et al. 2005]. The recovery period between each sprint has been to brief for differences in VO2max to have a large effect on PCr resynthesis.

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Stone N. & Kilding A. Aerobic conditioning for team sport athletes. Sports Med, 39: 615–642, 2009

Contact
a.stanula@awf.katowice.pl

RELATIONSHIP BETWEEN AEROBIC FITNESS AND RSA TEST PARAMETERS IN ELITE FEMALE BASKETBALL PLAYERS

MIKOŁAJEC, K.1, STANULA, A.1, GABRYS, T.2

1: AWF (KATOWICE, POLAND), 2: SSHE (OŚWIĘCIM, POLAND)

Introduction
Basketball is characterized by intermittent activity ranging from short bursts of high intensity to longer periods of moderate intensity and recovery [McInnes et al. 1995]. High aerobic fitness is an important feature to improve basketball performance [Abdelkrim et al. 2007], for example, enhancing the ability to recover from the anaerobic efforts during a game [Stone et al. 2009], to reiterate sprints or high-intensity accelerations with short recovery intervals [Spencer et al. 2005], and to prepare players to sustain an appropriate training load volume. The primary objective of this study was to determine a relationship between aerobic capacity (VO2max) and fatigue from high-intensity running in elite male basketball players.
Methods
41 elite female basketball players, members of the Polish National Teams participated in the study (U16, n=15; U18, n=12; U20, n=14). Each subject completed a repeated sprint ability (RSA) test consisting of 6 timed 30-m sprints, with 10 s of rest between subsequent efforts (photocells made by Microgate recorded the times of each sprint with accuracy of 0.01 s), and a progressive running test at 40 m distance (speed increasing from 8 km/h every 2 minutes by 1.5 km/h) until exhaustion (exhaled air was continuously sampled by an K4b2) and the rate of VO2, VCO2, VE were calculated every 5 seconds by an on-line computer system. Sum of time 6 repetitions (Σ6R), difference between 1 and 6 repetition (DIFF 1-6) as well as fatigue index (FI=((the fastest run time – the slowest run time)/the fastest run time) x 100) from RSA test was calculated [Oliver et al. 2009].
Results
The mean values (±SD) in terms of Σ6R, DIFF 1-6 and FI parameters equalled respectively, U16: 30.92±1.11, 0.67±0.17, 13.48±3.73; U18: 30.69±1.42, 0.61±0.11, 12.49±2.76 and U20: 31.45±1.79, 0.77±0.18, 15.88±3.39. The analysis of results showed significant correlation between VO2max value and DIFF 1-6 variable in the group of U18 national team players (r=–0.68, p=0.03).
Discussion

No significant relationship between VO2max value and RSA test parameters recorded in the study seems to indicate that running distance of RSA test was no sufficient to apply the process of re-synthesis of ATP under aerobic conditions [4].The recovery period between each sprint has been to brief for differences in VO2max to have a large effect on PCr resynthesis.

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Stone N. & Kilding A. Aerobic conditioning for team sport athletes. Sports Med, 39: 615–642, 2009

Contact
k.mikolajec@awf.katowice.pl

EFFECT OF THE ORDER OF EXERCISES RESISTED IN THE NUMBER OF REPETITIONS IN ELDERLY WOMEN

COSTA, L.1, LEITE, T.1, COSTA, T.1, SOUSA, O.1, WALTER, C.1, DE SIQUEIRA-FILHO M.1, LEITE, R.2.
FEDERAL UNIVERSITY OF MARANHÃO

Introduction
Resistance training is important strategy to prevent muscular atrophy in elderly (Franzke et al., 2015). The American College of Sports Medicine recommends that resistance training sessions begins with large muscle groups exercise (ACSM, 2009). However, there are few scientific evidences about exercise order and volume repetition in elderly. Thus, the aim of the present study was to analyse the effect of upper limbs exercises order on maximum repetitions in elderly women.
Methods
Ten sedentary elderly women, 68±3 years; height 1.5±0.05 m; weight 65.3±3.3 kg and body mass index 29.7±7.6 kg/m2, performed anamnesis, physical evaluation, exercise familiarization, submaximal muscle strength (maximum 10 repetitions test). The participants performed two sequences with different orders: Sequence A (SEQA) - Bench Press (BP), Pull Down (PD), Shoulder Press (SP), Barbell Curl (BD) and Triceps Pulley (TP) or Sequence B (reverse order). For each exercise, was performed three sets of 80% of 10 RM load with 2 minutes' interval between each sets and exercises, and seven-day between the sequences. The maximum number of repetitions in each training sets was recorded.
Results
Sequence A presented a significantly higher number of repetitions in the second (13.3±2.1, p=0.032) and third (13.4±2.3, p=0.017) series compared with SEQB (second set:11.4±3.2; Third set:10.6±3.0) for bench press exercise. In constrast, when analysed the number of repetitions for Barbell curl and triceps pulley were observed significantly higher values for SEQB when compared with SEQA in the second (SEQA:12.40±2.1; SEQB:14.9±2.0, p=0.008) and third set (SEQA:14.4±3.8; SEQB:17.6±3.9; p=0.003), respectively.
Discussion
A greater number of repetitions were observed in the beginning of the session when compared with final exercise session for both order. Ribeiro et al (2014) observed the same results with greater number of repetitions in the bench press and triceps pulley exercises at the beginning of the sessions, in untrained men. The greater metabolic demand in the beginning induces higher metabolites levels can help to explain the greater number of repetitions in the SEQA when compared with SEQB (Balsamo et al, 2013).

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Contact
laissa.fta@gmail.com

LACTATE INDICES WITHIN ONE CYCLE WEEK OF TRAINING OF HIGH SKILLED WEIGHTLIFTERS

SIVOKHIN, I., FYODOROV, A., TAPSIR, M., OGIENKO, N., MOROZOVA, D.
KOSTANAY STATE PEDAGOGICAL INSTITUTE

Introduction
Biochemical methods for monitoring blood lactate and analysis of the studied parameters during sport training are informative methods assesment of athlete body's reactions response to training load.
Lactate indices can be used for management of sport training of highly skilled weightlifters.
The purpose of research - to analyze blood lactate indices of highly skilled weightlifters in the week cycle training session.
Methods
In the study involved highly skilled weightlifters (n=6).
For determination the lactate concentration in the peripheral blood was used the special device - The Accutrend PlusandCobas (Germany), what allows to determine the required values in a training room for one minute.
Blood sampling was carried out during the evening training session, which took place from 17.00 to 19.00.
Results
The main volume of the load was carried out in the following areas of maximum intensity by day microcycle: monday - 80-90%; tuesday - 70-80%; wednesday - 80-90%; thursday - 60-70%; friday - 90-100%; saturday - 75-85%.
The results of investigation show that after exercise lactate concentration of athletes increased by an average of 79% and it is - 5.2 mmol/l, S = 2.2. After 20 minutes, the lactate concentration is reduced by 63% and it is - 3.2 mmol/l, S = 1.2.
The individual differences of lactate changes after the training load of weightlifters have some distinctions. The maximum values of lactate of some athletes increased to 10.2 and 9.8 mmol/l, while the maximum values of others were within 7.2; 6.8; 4.2 mmol/l.
Discussion

Analysis of the dynamics of lactate changes day by day microcycle week shows that on monday, tuesday and wednesday, its concentration tends to increase between 5.0 and 5.2 to 5.8 mmol/l. Maximum observed concentration of lactate in the wednesday.
On thursday, the athletes performed restoring load in the intensity zone of 60-70% of the maximum. Averages lactate was at 4.8 mmol/l.
On friday, the lactate values were in the range of 4.9 mmol/l, despite the fact that athletes perform maximum load in the intensity zone of 90-100%. Relatively low levels of lactate after such training can be associated with a relatively small amount of training load. The total number of lifts in the training session were lower by 20-30%.
On saturday, on the contrary, lactate values increase sharply and reach the value of 5.5 mmol/l.
Correlation analysis showed that the absolute level of performance between sports results and the average value of lactate concentration immediately after exercise there is a statistically significant correlation r=0.904 ($p<0.05$).
This relationship can be explained by the fact that athletes have a higher level of sportsmanship differ in the structure of the muscle groups that determine the effect of the working of motor actions.
Contact
alexfyodorov@mail.ru

MAXIMUM ISOMETRIC GRIP STRENGTH IN TOP-LEVEL CZECH TENNIS PLAYERS

STRAŠILOVÁ, K., KADERKA, I., BOZDĚCH, M., ZHÁNĚL, J.
MASARYK UNIVESITY BRNO

Introduction
In contemporary tennis, there is an obvious tendency to physically demanding game with strength, speed, strength endurance, and specific coordination being important determiners of sports performance. There are a number of studies dedicated to the diagnostics of the maximum isometric strength (MS) level in tennis using the hand grip dynamometer. This contribution deals with an analysis of the results of longitudinal observation of the MS level in top-class Czech tennis players.
Methods
The longitudinal research was realized with three top-class tennis players (the best ATP Ranking No. 4, No. 35, No. 72) in the game categories U12, U16, and U18 years old in 2000-2015.
Testing of the MS (dominant hand) was done using the hand grip dynamometer Grip-D (Takei) in compliance with the protocol European Test of Physical Fitness Handbook [Eurofit]. The results of the MS have been compared with the norms of the Czech Tennis Association (CTS), Laboratory of Physical Education (LPE, Japan), and the German Tennis Association (DTB).
Results
Bodily height of all three players in the adult age is above average (194, 192, 195 cm), which is a factor enabling a high level of the MS (Ferrauti et al., 2014; Zatsiorsky & Kraemer, 2006). During the longitudinal observation, the players in categories U12, U16, and U18 achieved these results in hand grip strength: No. 4 (31.0, 50.4, 61.5 kp), No. 35 (29.5, 54.0, 52.9 kp), No. 72 (23.8, 40.5, 51.5 kp).
Discussion
The assessment of the importance of level differences in the MS of three top-class players when compared to the norms of the CTS, DTB, and LPE has been made using the calculation of the critical difference dkrit (U12: dkrit=1,8 kp, U16: dkrit=2,5 kp, U18: dkrit=2,7 kp). The comparison with the norm results of the CTS, DTB, and LPE for the categories U12 (DTB: M=21.7 kg, CTS: M=25.1 kp, LPE: M=23.0 kp), U16 (DTB: M=39.7 kg, CTS: M=46.0 kp, LPE: M=42.2 kp), and U18 (DTB: M=49.8 kg, CTS: M=50.1 kp, LPE: M=46.7 kp) has proved that players No. 4 and No. 35 achieved a significantly above-average level of the MS in all game categories and player No. 72 achieved mostly a medium level of the MS. Hand grip strength can be thus considered an important factor of sports performance in tennis.
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PERFORMANCE DOES NOT DIFFER BETWEEN OFFICIAL AND SIMULATED ARCHERY COMPETITIONS

MONZONI, R., LUCERTINI, F., FERRI MARINI, C., FEDERICI, A.
UNIVERSITY OF URBINO CARLO BO

Introduction
Recent studies found physiological and psychometric differences, in elite basketball (Moreira et al., 2012a) and jiu-jitsu (Moreira et al., 2012b) athletes, between official (OC) and simulated competitions (SC). Archery is a sport characterized by only one automated technical skill (Tursi and Napolitano, 2014) that lasts just few seconds, thus it is easy to simulate a competition with research purposes. However, to our knowledge no studies evaluated any difference between archery OC and SC and this does not allow to use SCs instead of OCs in research settings. The present study aimed to assess if archers' performances differ between OC and SC. The influence of different training regimens was evaluated as well.
Methods
24 male athletes (age 22.8±2.1; BMI 23.7±2.1) with at least 4 years of archery experience were recruited and their performances (i.e. total score) were recorded during an OC and a SC, before and after 3 different training (6 months) regimens (subjects were randomly assigned to the groups). The first group underwent solely a specific technical training program (3 sessions per week, 90 min per session). The other groups also engaged (3 sessions per week, 90 min per session) in either a resistance training program based on weight machines only (group 2) or a specific training program characterized by elastic bands and calisthenics exercises aimed at simulating the shooting technique. In order to assess if the type of competition could affect the performance, the total scores of the OC and SC performed before the training periods were compared using a 2-tailed paired sample t-test. Thereafter, a mixed between-within subjects ANOVA was run to assess if the performance, during OC or SC competitions (within factor), was influenced by the type of training (between factor) and/or the time (within factor), i.e. before and after training. Alpha was set at 0.05.
Results

No statistical difference (p=0.969) was found between the pre-training scores of OC (520.08±11.16) and SC (520.13±11.05), which resulted strongly (r=0.89) and significantly correlated (p<0.001). Also, training type, time, and time x type interaction did not affect the scores of OC and SC, which always resulted not significantly different.

Discussion

The results highlight that conducting an OC or a SC to evaluate the athletes' performance yield similar results and those results do not seem to be influenced by training. Therefore, archery SCs appear to be well representative of OCs, regardless the training program used. Hence, SCs could be used instead of OCs in research settings.

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Contact

riccardomonz@gmail.com

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