Sport Sci Health
https://doi.org/10.1007/s11332-024-01174-z

ABSTRACT

XIV National Congress SISMES

Validity of commercial wearable sensors measuring respiratory frequency in soccer players

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Purpose: Evidence suggests that respiratory frequency (f_R) is a good marker of physical effort during different exercise modalities, including running-based activities characterized by supramaximal intensities, accelerations, decelerations, and changes of directions commonly performed in soccer and other team sports. Important technological advances have been made in recent years and some commercial wearable sensors are currently available, but it is unclear if they are suitable for measuring f_R in soccer. We assessed the validity of three strain-based commercial wearable sensors during soccer-specific exercises.
Methods: In two separate visits to the soccer pitch, ten male soccer players performed the same 30-min validation protocol characterized by soccer movements and activities, including running with the ball and intermittent shuttle runs. During the two visits, participants were asked to wear either a ComfTech vest (Howdy Senior, ComfTech s.r.l. ®, Monza, Italy) or a Bioharness™ 3.0 strap (Medtronic, Boulder, CO, USA) and a Tyme Wear™ vest (Boston, MA, USA). In both visits, a custom-made wearable mask integrating a temperature sensor was used as a reference system for validating f_R values extracted from the respiratory waveform recorded with the three commercial devices.
Results: The time course of f_R obtained with the ComfTech vest and the Tyme Wear™ vest fairly resembled that obtained with the reference system, even during intermittent shuttle runs, where fast changes in f_R to the alternation of work and rest phases were observed. The mean absolute error was generally lower than 3 breaths•min^{-1} for both the ComfTech vest and the Tyme Wear™ vest, while it was higher than 5 breaths•min^{-1} for the Bioharness™ strap in some participants. The error of measurement was affected by the algorithm used to extract f_R from the respiratory waveform, and a considerable degree of interindividual variability was found for all three devices.
Conclusions: Different wearable sensors are potentially suitable to monitor f_R in soccer, but their performance may change substantially based on the algorithm used to compute f_R. The specific measurement challenges posed by the soccer scenario should be carefully considered when developing devices and algorithms aiming to monitor f_R in this context.

Validity of two new RPE-scales to assess physical and psychological load of training and competition

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Purpose: The purpose of this cross-over randomized study was to investigate the discriminant validity of two new RPE-based scales to assess physical and psychological load of training and competitions.
Methods: 30 young physically active adults (10 females) were tested on a treadmill in a single laboratory visit. After a preliminary test to establish the speed correspondent to 50–60% HRmax (Low Physical Load, LPL) and 80% HRmax (High Physical Load, HPL), participants were tested in four different conditions: LPL, HPL, LPL + Cognitive Load (LPL + CL) and HPL + Cognitive Load (HPL + CL). In all conditions participants ran for 5 min with 10 min rest between runs. The cognitive load was added by asking the participants to perform a free-memory recall task whilst running. At the end of each run, participants were asked to rate how mentally and physically demanding the task was, using the NASA-TLX scales, overall RPE scale and the two new RPE scales in a random order. The Physical RPE scale concerned the muscular and respiratory effort experienced during the task. The Mental RPE scale concerned the subjective cognitive, emotional and motivational demands of the task. Heart rate was monitored continuously during all tasks. Fully 2 by 2 Repeated Measure ANOVAs were used to assess differences between conditions (known-differences validation method). Within-subjects correlation coefficients between the new RPE scales and the criterion (NASA-TLX scales) were calculated using Bland Altman method.
Results: The physical RPE scale and the Mental RPE scale were significant correlated with the physical demand NASA-TLX scale ($r = 0.704$, $p < 0.001$) and the mental demand NASA-TLX scale ($r = 0.903$, $p < 0.001$), respectively. There was a significant Physical x Cognitive Load interaction on the Physical RPE scale ($p = 0.007$).

Published online: 22 May 2024

Results: Regarding the DASH questionnaire, descriptive statistics (mean ± SD) showed a 23.6% (SD: 20.8) decrease from the beginning (22.1% ± 17.2%) to the end (17% ± 12.2%) of the intervention. Concerning the upper limb strength, results showed an increase in strength expressed in both limbs (homolateral pre: 16.75 kg—ipsilateral post: 21.375 kg; contralateral pre: 22.00 kg—contralateral post: 22.75 kg).
Conclusions: The results obtained seem to recognize aqua fitness as an activity indicated for counteracting the side effects of the treatments for breast cancer. In fact, an improvement was noted in most of the subjects analyzed as regards the degree of disability of the hand, limb and shoulder. As far as strength is concerned, however, in all subjects participating in the activity, an increase in muscle strength was recorded in the limbs, both in the homolateral and contralateral limb.
Acknowledgments: We thank the national association of women with breast surgery (ANDOS) section of Fondi for participating in the study with their associates; we also thank the Sport Village Fondi club for the hospitality and availability provided during the intervention period.

Water runs quality of life: the effect of a water-based exercise program on shoulder joint mobility in breast cancer survivors

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Purpose: According to recent metanalysis, adapted physical activity (APA) has shown its effectiveness in improving quality of life (QoL) and psychophysical health in cancer survivors. Therefore, the present study aims at investigating the effect of a water-based exercise program on shoulder joint mobility in breast cancer survivors.
Methods: The exercise program included a group of 9 Breast Cancer Survivors (Age: 52.6 ± 10.1 years; Weight: 69.5 ± 11.7 kg; Height: 1.66 ± 0.07 m; BMI: 25.0 ± 2.7 kg/m^2) who underwent surgery such as mastectomy or segmentectomy. Inclusion criteria were a good health status at the time of intervention, no contraindication highlighted by their oncologists, and no radiopharmaceutical assumed for the last three months. APA program consisted in 4 months supervised of water-based classes for a total of 13 workout sessions. Assessments included the back scratch test (for both the dominant and the contralateral limb) for the evaluation of upper limb range of movement (ROM), and shoulder circumduction test using a wooden wand to facilitate the measurements. Assessments have been administered prior the beginning (pre) of the intervention protocol and one week after the end of the program (post).
Results: Descriptive statistics (mean ± SD) revealed a significant distance reduction between hands in the back scratch test. In particular, a reduction of 5.1 cm with the left upper limb on the right one (pre: 14 ± 9.6 cm; post: 8.9 ± 7.1 cm), and 2.8 cm with the right upper limb on the left one (pre: 8.1 ± 8.8 cm; post: 5.3 ± 6.5 cm). Although there have been improvements for both sides, better results were obtained when the dominant limb was in elevated position. As far as the shoulder circumduction test is concerned, not every patient has been able to perform it. However, comparing available data, an improvement of 5.9 cm has been obtained (pre: 99.9 ± 8.2 cm; post: 94 ± 9.0 cm).
Conclusions: Results of the present pilot study showed that a supervised and water-based APA program can lead to significant improvements of both muscles' elastic properties and shoulders' joint mobility in breast cancer survivors. Moreover, it may result in potential improvements of patients' quality of life by facilitating their everyday activities.

Acknowledgments: Authors would like to thank all the patients involved in the study.

On acute mountain sickness when travelling at high altitude

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Purpose: Altitude travelling has become popular, both for mountainneering, training, and hiking. However, lowlanders exposed to high altitude are at high risk for the high-altitude diseases, such as acute mountain sickness (AMS), particularly with rapid ascent plans. This work aims to evaluate prevalence of AMS during two common treks across either the Alps or Himalayas.
Methods: The Alpine study involved a group of 15 healthy adults (8 males and 7 females, 34.6 ± 11.9 years, BMI of 22.7 ± 3.4 kg/m^2), trekking up to Capanna Margherita (≈4550 m of altitude). The Himalayan study involved a group of 21 healthy adults (12 males and 9 females, 44.8 ± 15.6 years, BMI of 24.6 ± 3.4 kg/m^2), trekking up to the Pyramid Laboratory—Observatory (≈5000 m). The first was characterized by a rapid ascent plan, while the second envisaged more adequate stages of ascent. In both cases, before reaching the peak altitude all participants took 250 mg of acetazolamide per os once daily. AMS was verified with the Lake Louise score and defined as ≥ 3 points in the total score at least 6 h after the ascent, with at least one point from headache.
Results: In the Alpine study, 6 (40%) participants suffered from mild AMS; this proportion was lower than that reported by Mandolesi et al. [1]—24/50 (48%), whose 15 with moderate-to-severe AMS—and Modesti et al. [2]—31/44 (70%); both studies were conducted at Capanna Margherita, involving participants with similar age range and BMI. In the Himalayan study, 7 (33%) participants suffered from mild AMS; this proportion was lower than that reported by Boos et al. [3] at ≈5140 m—38/80 (47.5%)—and comparable to that reported by Modesti et al. [2] at ≈5400 m—16/47 (34%).
Conclusions: The lower percentage of participants with AMS in our studies is probably due to the use of acetazolamide, which was not mandatory in the other studies herein cited. It is possible that biases emerge whether comparing AMS diagnosed by the most recent scoring system [4] to AMS diagnosed by previous systems, although the difference are likely little, if any. As evident, the hypothesis that the higher the altitude the greater the risk of developing AMS can be reverted, at least below extreme altitudes, by avoiding rapid ascent plans.
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