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Effect of Physical Activity Behaviors, Team Sports, and Sitting
Time on Body Image and Exercise Dependence

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ABSTRACT

Background and Purpose

Mental health is a fundamental component of overall well-being, closely linked to quality of life and influenced by lifestyle factors such as smoking, diet, alcohol consumption, and high sitting time behavior. Physical activity, exercise, and sport participation are widely recognized as protective determinants, reducing anxiety and depression while enhancing self-confidence, self-efficacy, and body image. Body image is a multidimensional construct that includes perceptual, cognitive–affective, and behavioral dimensions. The effect of exercise or sport on body image may be due the improvements in physical fitness and body composition; however, athletes may also experience body dissatisfaction due to aesthetic ideals, weight categories, or performance-related pressures. This paradox reflects sport-specific demands that can develop maladaptive behavior such as unhealthy diet, worst chronotype or exercise dependence. Moreover, sex differences play a key role on body image, where women are often more dissatisfied with their bodies. Beyond body image, other lifestyle factors, particularly dietary adherence and sleep quality, are key determinants of both health and performance. Adherence to the Mediterranean diet, characterized by fresh and minimally processed foods, supports metabolic and cardiovascular health, enhances sleep quality, and reduces the risk of chronic diseases and psychological disorders. Sleep quality is essential for physical recovery, increase performance, and mental health, but athletes frequently could develop poor sleep quality given the higher training demands and competitive stress. The interaction among body image, diet, and sleep highlights the need for a multidimensional perspective when examining the health and well-being of athletes and physically active populations.

In Italy, soccer and volleyball are the most practiced team sports among young adults, providing a relevant context to study these dynamics, particularly given the sociocultural pressures. Given the complex link between physical activity, perception of one’s own body, excessive exercise, healthy

diet, and sleep quality, there is a need for an in-depth investigation that examines these dynamics in populations with different physical activity behaviors. Therefore, this doctoral research aims to investigate, through a multidimensional approach, how lifestyle behaviors, including team sport participation, physical activity levels, and high sitting time behavior, relate to body image, exercise dependence, dietary adherence, and sleep quality, also considering sex differences.

Methods

Three cross-sectional studies were conducted in the Human Performance Lab of the University of Cassino and Lazio Meridionale, in accordance with the Declaration of Helsinki and IRB approval (8 March 2023; approval number: 9407). Young adults (18-35 years) were recruited among the student and student athlete population of the University of Cassino and Lazio Meridionale, testing individually during afternoon sessions (around 30 min). Student-athletes who reported regular team sport participation were included if they had ≥ 4 years of training in the sex-typical Italian team sport (males: soccer; females: volleyball) and competed at the Tier-2 amateur level. Non-athletes were classified into (i) physically active individuals (males and females) if they recognized as health-enhancing physical activity by the International Physical Activity Questionnaire or (ii) individuals with high sitting time behavior (males and females) if reported sitting time 5 or more hours in total each day.

Body image and exercise dependence were assessed with the Italian Body Image Dimensional Assessment (BIDA) and 21-item Exercise Dependence Scale (EDS-21). BIDA is a silhouette-based scale, where three direct indices are derived from the participants' responses: body dissatisfaction, sexual body dissatisfaction, and comparative body dissatisfaction. EDS-21 is a six-point Likert scale that evaluates seven dimensions of exercise dependence (tolerance, withdrawal, intention effects, lack of control, time, reductions in other activities, and continuance) and provides an overall score. The dietary adherence was assessed using the Italian version of the 14-item questionnaire for the assessment of PREvención con DIetaMEDiterránea (PREDIMED). Scores of 1 and 0 were assigned for each item; the PREDIMED score was calculated as follows: 0–5, lowest adherence; score 6–9,

average adherence; score ≥ 10 , highest adherence. Regarding sleep quality and chronotype, the Pittsburgh Sleep Quality Index (PSQI) questionnaire and the Morningness–Eveningness Questionnaire (MEQ) were used. PSQI consists of seven components, including subjective sleep quality, habitual sleep efficiency, sleep medication use, sleep duration, sleep latency, sleep disturbances, and daytime dysfunction. The PSQI score is a global score ranging from zero to 21, and poor sleep quality was defined as a PSQI score of 5 or greater, while good sleep quality was defined as a PSQI score of less than 5. The MEQ consists of 19 questions regarding sleep habits and daily performance. The sum of the individual items produced a total score ranging from 16 to 86, and based on their score, individuals were classified as morning (59–86), neither (42–58), or evening (16–41) chronotypes.

The statistical analysis from this project includes the following:

Phase I: A multivariate analysis of variance (MANOVA) was used to examine the effects of different levels of physical activity, team sport participation (soccer and volleyball), and high sitting time behavior on participants' body image indices and dimensions of exercise dependence according to sex.

Phase II: One-way analysis of variance (ANOVA) examined differences between student-athletes and non-athlete students with high sitting times on PREDIMED, PSQI score, the seven component scores of sleep, MEQ, and BIDA scores.

Phase III: One-way ANOVA was used to compare PSQI score, PREDIMED score, and MEQ score among soccer players, physically active individuals, and individuals with high sitting time behavior. Pearson's correlation coefficients (r) were calculated to examine the associations between PSQI score, PREDIMED score, and MEQ score.

Results

The main findings from this project include the following:

Phase I: Volleyball players showed significantly higher body dissatisfaction than soccer players and the male physically active group, who had lower values than the female high sitting time behavior

group. Soccer players had lower comparative body dissatisfaction values than volleyball players, and females with high sitting time behavior, who had higher values than males with high sitting time behavior. Females with high sitting time behavior had significantly lower exercise dependence scale score than volleyball players, soccer players, and physically active males.

Phase II: Student-athletes showed significantly higher adherence to the Mediterranean diet, although experiencing poorer sleep quality compared to non-athlete students with high sitting time. Conversely, comparative body dissatisfaction was significantly higher in non-athlete students with high sitting time than in student-athletes.

Phase III: Better sleep quality was found in amateur soccer players and physically active individuals than in individuals with high sitting time behavior. No significant differences were found in adherence to the Mediterranean diet and chronotype. A negative relationship was observed between chronotype and sleep quality among individuals with high sitting time.

Conclusions

The findings highlight the impact of regular physical activity on body dissatisfaction and the variance in body image perceptions between the sexes. The high exercise dependence values found in volleyball and soccer players and physically active males suggest an effect of intense training and maladaptive exercise behaviors, underlining the need for comprehensive strategies to address exercise dependence. Moreover, the findings highlighted a paradoxical health pattern in female student-athletes who combine healthier eating habits with poorer sleep quality. Structured behavioral routines in amateur soccer may support a good sleep quality, although adherence to the Mediterranean diet appears independent of amateur sport participation.

These findings suggest that participation in sports alone may not be sufficient to promote healthier dietary habits or protect against body image concerns. Multidimensional strategies that integrate physical activity, nutritional education, and body image awareness are needed to improve health-related behaviors and psychological well-being in university and athlete-students.

LITERATURE REVIEW

1. Mental health and lifestyle behaviors

The World Health Organization (WHO) defines mental health as a state of mental well-being that enables people to cope with the stresses of life, realize their goals, work productively, and contribute to their community [1]. This definition is reflected by the individual's perception of their position in life, goals, expectations, standards, and concerns, defined as quality of life (QoL) [1]. Mental health is fundamental to well-being, and mental disorders are real health conditions, given their contribution to morbidity, premature mortality, and decreasing QoL [1]. To promote mental health, it is necessary to address negative health behaviors such as smoking, diet, alcohol consumption, and high sitting time behavior [1,2]. Within this perspective, mental health is the result of multiple interacting lifestyle behaviors rather than isolated factors. Physical activity and sport, high sitting time behavior, body image, and dietary habits represent modifiable determinants that contribute to well-being and quality of life, particularly in young adults.

2. Body image

Within determinants of mental health, body image plays a key role. Body image is a multidimensional construct encompassing the thoughts, feelings, and behaviors of an individual related to their own appearance [3]. The perceptual dimension constitutes how one sees and describes their body appearance and function, whereas the cognitive dimension assesses thoughts about one's body appearance and function. The affective dimension is focused on the individual's feelings and emotions about their body appearance and function, and the behavioral dimension assesses behaviors resulting from perceptions, thoughts, and/or feelings about body appearance and function [3]. The health implications of a negative body image and body image disorders cannot be overstated. From a mental health perspective, poor body image has been linked to low self-esteem, is believed to be a cause of depression and anxiety, and plays a significant role in the etiology of eating disorders such as anorexia nervosa and bulimia nervosa [4,5]. From a physical health perspective, body image

concerns have been shown to influence health risk behaviors such as smoking, alcohol and drug use, and pathological weight loss behaviors (e.g., extreme dieting and use of diet pills) [4,5]. Cultural representations of body ideals differ between females and males [6]. For females, the ideal body emphasizes thinness combined with sexual features (e.g., large breasts, long legs, full lips), a standard reinforced by media, fashion, and beauty practices. Females are encouraged to pursue bodily perfection through dieting, cosmetic practices, and surgery, with appearance closely tied to perceptions of social and romantic success [6]. By contrast, the males ideal emphasize muscularity, leanness, and a V-shaped torso, reflecting not only appearance but also strength, dominance, and competitiveness. Males often strive for this ideal through weight training, supplements, and in some cases, anabolic steroids [6]. The “drive for muscularity” has become a central construct in understanding male body dissatisfaction, though appearance is less central to male identity compared to female [6]. Body image showed sex differences. In fact, females report higher levels of body dissatisfaction, greater social pressure to conform to ideals, more frequent dieting and cosmetic surgery, and higher rates of eating disorders. Males, instead, show higher engagement in behaviors aimed at muscle enhancement, as exercise addiction [6]. These sex-specific body ideals highlight the importance of considering sex as a central moderating factor when investigating body image and related health behaviors in physically active and athletic populations.

3. Physical activity, sport participation, and body image

Physical activity, exercise, and sport participation represent central lifestyle behaviors that can shape both physical and mental health outcomes, including body image. WHO defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure [7]. When physical activity is planned, structured, repetitive, and purposeful, aiming at the improvement in or maintenance of one or more components of physical fitness, it is defined as exercise. Sport is described as a range of activities performed within a set of rules and undertaken as part of leisure or competition [8]. Physical activity, exercise, and sports practices are beneficial to health and well-being, and conversely, physical inactivity increases the risk of non-communicable diseases (NCDs)

and other poor health outcomes [7]. Together, physical inactivity and high sitting time behavior are contributing to the rise in NCDs and placing a burden on healthcare systems. People who are insufficiently active have a 20% to 30% increased risk of death compared to people who are sufficiently active [7]. Regular physical activity is associated with improved physical fitness, cardiometabolic health, risk of cardiovascular disease mortality, bone health, cognitive outcomes, and mental health [7]. In particular, there is an increasing amount of evidence [9] documenting the beneficial impacts of physical activity on mental health, with studies examining the effects of both brief bouts of exercise and more extended periods of activity. Numerous psychological effects, such as self-esteem, cognitive function, mood, depression, and quality of life, have been studied [10]. Exercise could also promote improvements in self-efficacy, as well as objective and perceived physical fitness (i.e., body composition, cardiorespiratory endurance, and muscular strength), all of which lead to improvements in body image [11]. The contribution of exercise to improvements in body image might be attributed to the fact that individuals who engage in regular physical activity more closely resemble the aesthetic ideal of a lean and fit physique for females and a lean and muscular physique for males with respect to non-exercisers. The effect of exercise or sport on body image may also be due to the fact that physical activity participation is associated with an increase in psychological well-being that is related to a positive body image [12]. Within the exercise and body image literature, three broad categories of variables have been identified as potential mechanisms underlying the effects of exercise interventions: objective improvements in physical fitness, perceived improvements in physical fitness, and increases in self-efficacy [5]. According to Martin Ginis et al. [5], in their chapter handbook, based on the reviewed studies, they showed that objective improvements in physical fitness, such as changes in body composition, aerobic capacity, or muscular strength, account for only a small portion of exercise-related body image improvements. Instead, perceived improvements in fitness and increases in self-efficacy emerge as far stronger predictors. These findings suggest that exercise enhances body image primarily through psychological mechanisms, especially the interpretation of change, rather than through actual physical

improvements [5]. However, the relationship between physical activity and body image is not universally positive. In some individuals, body dissatisfaction may motivate excessive exercise as a strategy to control body weight or appearance, increasing vulnerability to maladaptive exercise behaviors.

4. Exercise dependence and sport-specific demands

Despite studies showing how exercise and sport are beneficial for both psychological and physical health, there is a general consensus that excessive exercise may lead to addictive inclinations [13,14], such as dependence, characterized by a compulsion to train, resulting in uncontrollable excessive exercise behavior. This results in physiological and psychological symptoms that could have a negative impact on mental health, such as depression and anxiety [15]. Individuals who exercise frequently may feel unable to reduce their exercise; continue despite illness, injury, and social conflict; and experience “withdrawal symptoms” when forced to stop [15,16]. With body dissatisfaction, there are sex differences in exercise dependence, where males generally are at higher risk of developing maladaptive exercise behavior than females [17], given the greater motivation to exercise and increase the amount and intensity of training [17–19]. These findings highlight the importance of considering both sex and sport context when examining the relationship between body image and exercise behaviors.

Because exercise has a positive effect on physical appearance, one of the reasons for exercise dependence is improving body image. Individuals exercise with the aim of enhancing fitness levels and achieving a desired physique, leading in turn to an increased risk of exercise dependence [15]. Athletes can also experience exercise addiction due to an obsession with achieving top performance and results [15]. Moreover, different sports elicit different physical, psychological, and social demands, all of which can significantly influence both self-perception and exercise-related behaviors. Among the team sports, soccer and volleyball are the most popular among the Italian young adult population [20]. These sports differ in training characteristics, aesthetic demands, and social

representations, making them particularly relevant contexts for investigating body image and exercise dependence within sport-specific environments.

5. Sleep, diet, and chronotype as interconnected lifestyle behaviors

Beyond body image and exercise behaviors, mental health and well-being in physically active populations are influenced by additional lifestyle factors, including sleep quality, dietary habits, and circadian rhythm preferences. These behaviors are increasingly recognized as interconnected components of a broader lifestyle framework. Student-athletes represent a specific population facing unique physical, psychological, and social demands. To achieve holistic development, student-athletes have the right to combine their higher sport and education careers (e.g., dual career), both of which are relevant to empowering their future role in society, especially at the end of their competitive sport period [15]. Optimal mental health and athletic performance cannot be sustained by focusing on a single behavior. Instead, a combination of interconnected lifestyle factors, including sleep quality, dietary habits, and body image, collectively influences psychological well-being, physical recovery, cognitive functioning, and overall quality of life in student-athletes. Disruptions in one area often affect others, warranting multidimensional health promotion strategies [21]. Student-athletes generally adopt healthy habits such as adherence to a balanced diet like the Mediterranean diet, which is known to support physical recovery, mental health, and positive body image. However, sleep quality is often poor in this population [22], creating a paradox where healthy nutrition contrasts with inadequate rest, potentially limiting the benefits of both. Regarding sleep behaviors, optimal sleep is vital for athletes, as sports performance depends on the cognitive, physiological, and physical integration [23]. Maximizing athletic performance is a primary objective for many student-athletes, particularly those aiming for athletic scholarships or professional careers [23]. Sleep deprivation negatively affects anaerobic capacity, sport-specific skills, and neurocognitive functioning [24]. Dual-career athletes, when compared to their student peers, might be more likely to present with sleep problems since they manage additional social roles and significant time demands, potentially negatively impacting sleep patterns and recovery processes [25]. Sleep quality of student athletes and

non-athletes-the role of chronotype, stress and life satisfaction [25]. Moreover, academic and training schedules may not align with their natural sleep preferences or chronotype (e.g., an individual's preferred timing for sleep and daily activities within a 24 h cycle), which might influence sleep quality, sleep duration, and social jet lag, particularly among populations with irregular schedules [26]. Dietary habits also interact with body image and sleep behaviors. A close relationship has been observed between dietary patterns and body image [27], while adherence to the Mediterranean diet has been associated with improved sleep quality and psychological well-being.

6. Rationale and aims of the doctoral research

Taken together, body image, dietary adherence, sleep quality, and chronotype represent interrelated lifestyle dimensions that may influence health and performance, particularly in young adults engaged in sport or characterized by high sitting time behaviors. Previous research [17,28–33] has typically examined these dimensions in isolation, despite growing evidence suggesting that they interact dynamically and may contribute to psychological well-being, recovery, and maladaptive behaviors. Despite growing interest in these domains, there remains a lack of research simultaneously addressing these interconnected lifestyle factors within the same theoretical framework, especially in populations balancing sport participation, academic demands, and high sitting time behaviors. This gap is particularly evident in dual-career athletes and in studies examining sex-specific differences, which remain underrepresented in sport and exercise science research [34].

Therefore, the present doctoral research adopts a multidimensional lifestyle approach to investigate how physical activity level, team sport participation, and sitting time behavior interact with body image, exercise dependence, sleep quality, dietary adherence, and chronotype in young adults. The three studies included in this thesis address complementary components of this framework across different populations and sport contexts. Specifically, the aims of this doctoral research were:

- I. To examine the effect of lifestyle, including team sport participation (i.e., soccer and volleyball), physical activity engagement level, and sitting time, and their effect on body image and exercise dependence according to sex. Given the documented sex and physical activity level

differences in body perception and exercise addiction [5,35], we hypothesized that team sport athletes, individuals with high levels of physical activity, and individuals with high sitting time significantly differ regarding body dissatisfaction, considering differences between the sexes, and that participants with high levels of physical activity and team sport athletes would show more exercise dependence than physically active individuals with long sitting time. This study contributes novel evidence by examining body image and exercise dependence across sex-specific sport contexts within the same framework.

II. To evaluate sleep quality, adherence to the Mediterranean diet, chronotype, and body dissatisfaction among female student-athletes compared to peers with high sitting time behavior. Previous studies suggest that athletes often adopt healthier dietary habits while simultaneously reporting compromised sleep quality due to dual-career demands [23,36,37]. However, few investigations have examined these factors concurrently in female populations [38]. Based on existing evidence, we hypothesized that student-athletes would demonstrate greater adherence to the Mediterranean diet but poorer sleep quality, reflecting the higher demands of training and competition. In contrast, we expected no substantial between-group differences in chronotype and body image, as these characteristics are likely inherent to the populations under study. This study addresses a critical gap by focusing on female student-athletes and integrating nutritional, sleep-related, and psychological dimensions within a dual-career context.

III. To evaluate the sleep quality, adherence to the Mediterranean diet, and chronotype among amateur soccer players compared to physically active and high sitting time behavior counterparts. A secondary aim was to investigate the associations between sleep quality, diet adherence, and chronotype within a non-professional soccer context. While professional athletes have been widely studied [39–41], amateur athletes represent a largely understudied population, despite constituting the majority of sport participants [42]. Existing evidence suggests that regular physical activity may support sleep quality [43], yet high sitting time behavior and evening chronotype are associated with poorer sleep outcomes [44,45]. We hypothesized that soccer players and physically active individuals

could report a good sleep quality compared to high sitting time behavior counterparts. Furthermore, a higher adherence to the Mediterranean diet and a morning chronotype could be associated with sleep quality. This study provides novel insights by examining whether structured amateur sport participation may act as a stabilizing lifestyle factor for sleep regulation, independent of professional-level demands

METHODS

The project was organized in three phases, aiming at:

- I. To examine the effect of lifestyle, including team sport participation (i.e., soccer and volleyball), physical activity engagement level, and sitting time, and their effect on body image and exercise dependence according to sex.
- II. To examine the effect of lifestyle, including team sport participation (i.e., soccer and volleyball), physical activity engagement level, and sitting time, and their effect on body image and exercise dependence according to sex.
- III. To evaluate the sleep quality, adherence to the Mediterranean diet and chronotype among amateur soccer players compared to physically active and high sitting time behavior counterparts.

In adherence to the Declaration of Helsinki, the research protocol, designed as a cross-sectional study, was approved on 8 March 2023 by the Institutional Review Board of the Department of Human Sciences, Society and Health at the University of Cassino and Lazio Meridionale (approval Number 9407). All participants provided informed consent and were informed of their right to withdraw from this study at any time and for any reason. Before starting each experimental session, participants' anthropometric characteristics were collected. Body mass (kg) and height (m) measurements were recorded using a Seca 709 scale equipped with an integrated stadiometer, with precision up to 0.1 kg for weight and 0.1 cm for height (Vogel & Halke, Hamburg, Germany). Body mass index (BMI) was calculated using the formula of weight in kilograms (kg) divided by the square of height in meters (m²). All participants were classified as young adults (aged between 18 and 35 years) and had a BMI within the normal range (18.5–24.9 kg/m²).

1. Phase 1: Effect of Physical Activity Behaviors, Team Sports, and Sitting Time on Body Image and Exercise Dependence

1.1 Study Design

This cross-sectional study was conducted in the Human Performance Lab of the University of Cassino and Lazio Meridionale, where all data were collected at a specific point in time, without any longitudinal follow-up. Data collection was conducted in the afternoon. The hour of data collection was chosen to accommodate the students' and student athletes' schedules, as they were free from training and university lectures at this time, ensuring their availability and minimizing conflicts with their academic and sport commitments. The inclusion criteria were clearly defined to select student athletes who engaged in team sports, students regularly participating in physical activity, or with long sitting time. After the recruitment and selection process of the participants, the individuals' body image and exercise dependence were evaluated.

1.2 Participants

Young adults were recruited among the student and student athlete population of the University of Cassino and Lazio Meridionale. To ensure that our study was robustly powered to detect substantial effects, we sought an effect size of 1.2, indicative of a very large impact by Cohen's standards, to reflect our commitment to identifying only the most meaningful significant differences. The rationale behind targeting such a marked ES was from the existing literature [13], focusing on the relationship between physical activity and health perception. In particular, targeting an alpha of 0.05 and a power of 0.80 across 6 distinct groups, our power analysis demonstrated that a sample size of approximately 16 participants per group was required for obtaining an effect size of 1.2. As highlighted by Schweizer and Furley [46], a large effect size was chosen because smaller samples have a higher likelihood of producing type II error (i.e., not yielding a significant test although the effect exists). Moreover, small samples make replication attempts particularly difficult. This may mean that the effect does not exist or that the study did not have enough power to detect it. For these reasons, a power of 0.80 and a large ES (1.2) was chosen. A convenience sampling method was used to recruit participants from the university population by means of flyers, posters, brochures, and advertisements on social network. To avoid the influence of age in our evaluation, only participants in the young adult category (aged between 18 and 35 years) were recruited. After the recruitment and selection processes, different

groups were divided based on their athletic and nonathletic status and sex: male soccer players and female volleyball players, highly physically active males and females, and males and females with high sitting time behavior.

1.3 Measures

The Italian short version (7 items) of the International Physical Activity Questionnaire (IPAQ) (Figure 1) was administered to the participants to evaluate the individual physical activity levels and sitting time. The IPAQ (Cronbach's α coefficient 0.60 [47]) comprises 7 items that evaluate the frequency, intensity, and duration of physical activity at various levels: low (such as walking), moderate, and vigorous, along with total physical activity per week. Additionally, it includes an item regarding daily sitting time to estimate sedentary lifestyle patterns. The IPAQ includes both categorical and continuous scores. The categorical scores classify participants into three levels: inactive, minimally active, and health-enhancing physical activity (HEPA) active, which denotes activity levels that exceed the minimum public health physical activity recommendations, which are associated with enhanced health benefits [47,48]. The continuous scores are calculated in metabolic equivalent of task (MET) minutes per week. To classify people according to the sports practiced, the participants were asked: "Do you currently have any injuries that prevent you from training or exercise? Do you practice any sports? If yes, please specify which sport and for how long." Since sedentary behavior, such as high sitting time, increases the risks of heart and metabolic diseases and the prevalence of psychological distress in adults, independent of the protective effect of leisure-time physical activity [49], it is crucial to consider the impact of long sitting time (>5 h per day) on mental and physical health [50,51]. Therefore, sitting time was used as indicator of sedentary behavior.

International Physical Activity Questionnaire (IPA-Q)

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling? (days per week)

2. How much time did you usually spend doing vigorous physical activities on one of those days? (minutes per day)

3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking. (days per week)

4. How much time did you usually spend doing moderate physical activities on one of those days? (minutes per day)

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time? (days per week)

6. How much time did you usually spend walking on one of those days? (minutes per day)

7. During the last 7 days, how much time did you spend sitting on a week day? (minutes per day)

Figure 1. The short version of the the International Physical Activity Questionnaire

1.4. Procedures

As showed in Figure 2, from a total of 140 participants, 20 were excluded because they did not fully complete the questionnaires. The remaining 120 participants were allocated according to their athletic status. If the participants reported practicing sports, they were allocated to the athletic students group, and the following inclusion criteria were applied: (i) student athletes engaged in the most popular Italian sports for their respective sexes [20], being soccer for males and volleyball for females; (ii) team sport training and competition for at least the previous 4 years. Participants were excluded if they had an injury that prevented them from training and competition or they practiced team sport for less than 4 years. From the 40 participants allocated to the athletic students' group, 9 were excluded because of not meeting the inclusion criteria, while 31 were allocated to the soccer players' group (n = 17) and volleyball players' group (n = 14). These inclusion and exclusion criteria were chosen to ensure that the student athletes had substantial and consistent experience in their respective sports to avoid the impact of variables such as injury or insufficient training duration on the evaluation. Participants included in the soccer and volleyball players' groups reported training on average for three 2 h sessions plus a competitive match per week. In according with the 6-tiered Participant Classification Framework [52], soccer and volleyball players were classified as Tier 2, corresponding to individuals engaging in sport-specific training approximately three times a week with the intention to compete at the local level. If participants did not report practicing sport, they were allocated to the nonathletic students and based on the IPAQ responses; the following inclusion criteria were applied: (i) students classified as HEPA active, or (ii) students that reported sitting for 5 or more hours in total per day. Nonathletic students were excluded if they reported less than 5 h per day of sitting time while not meeting the criteria to be classified as HEPA active. From the 80 participants allocated to the nonathletic students group, 15 were excluded because of not meeting the inclusion criteria. Therefore, the 65 participants from the nonathletic students group were included and allocated to the physically active group (male physically active group: n = 17; female physically active group: n = 15) and the high sitting time behavior group (male high sitting time behavior group: n = 16; female high sitting time behavior group: n = 17). The physically active group included

participants who met one of two criteria to be classified as HEPA active: either engaging in vigorous-intensity activity on at least 3 days per week, achieving a minimum of 1500 MET minutes per week; or participating in any combination of walking, moderate-intensity, or vigorous-intensity activities totaling at least 3000 MET minutes per week [47,48]. The high sitting time behavior group included individuals who reported sitting for 5 or more hours in total each day. The inclusion of participants in the high sitting time behavior group was independent of their actual levels of physical activity, whether inactive, minimally active, or HEPA active. This approach acknowledges that even individuals who engage in regular physical activity can still lead a largely sedentary lifestyle. The categorization in the high sitting time behavior group was based solely on the amount of time spent sitting, reflecting a lifestyle with minimal physical movement or exertion. The long sitting time in this group corresponds to an energy expenditure ranging from 1.0 to 1.5 METs, which is characteristic of sedentary behavior [51,53,54]. The threshold of 5 or more hours of sitting per day was selected based on the literature [51,54–56] that has identifies this time as the critical point having impacts on health outcomes such as increased risks of mortality, metabolic syndrome, and cardiovascular diseases and having negative psychological effects.

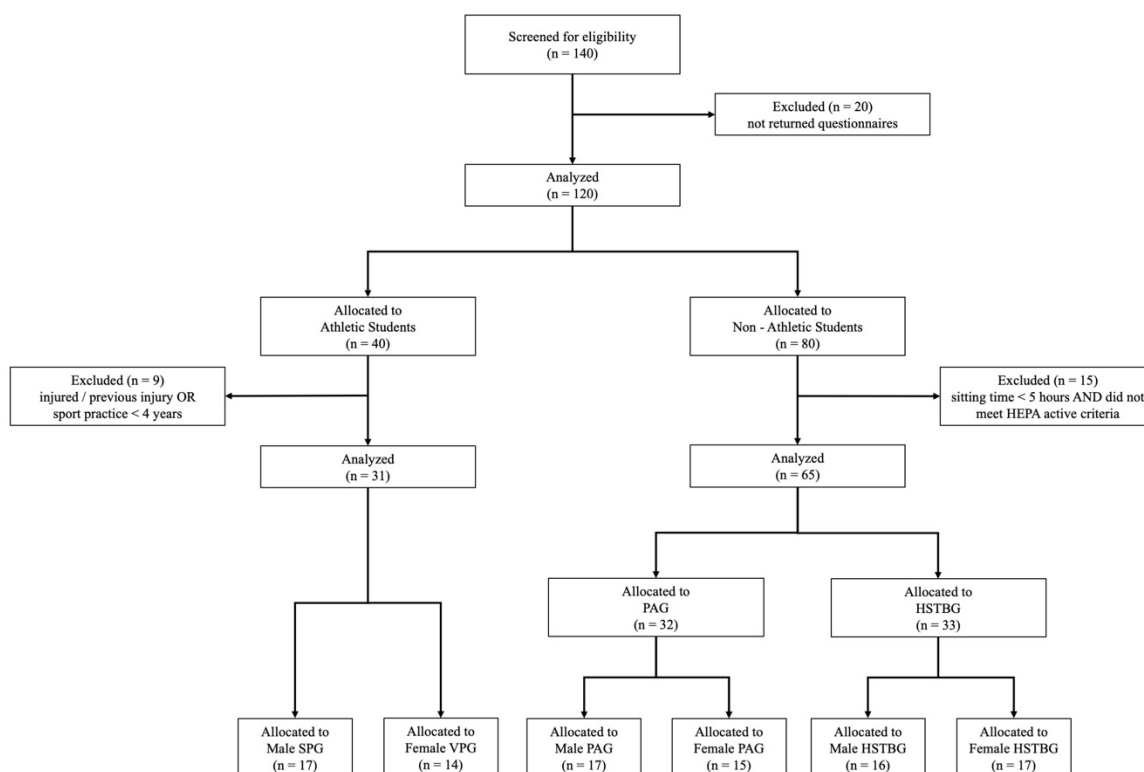


Figure 2. Flow chart of the recruitment and selection process of the participants included in the study. SPG = soccer players’ group, VPG = volleyball players’ group; PAG = physically active group; HSTBG = high sitting time behavior group, HEPA = health-enhancing physical activity.

The data collection (around 30 min) was individually carried out under the supervision of doctoral and master’s students in preventive and adaptive physical activity of the University of Cassino and Lazio Meridionale. Participants completed the Body Image Dimensional Assessment (BIDA) instrument and the 21-item Exercise Dependence Scale (EDS-21).

1.5. Body Image Dimensional Assessment

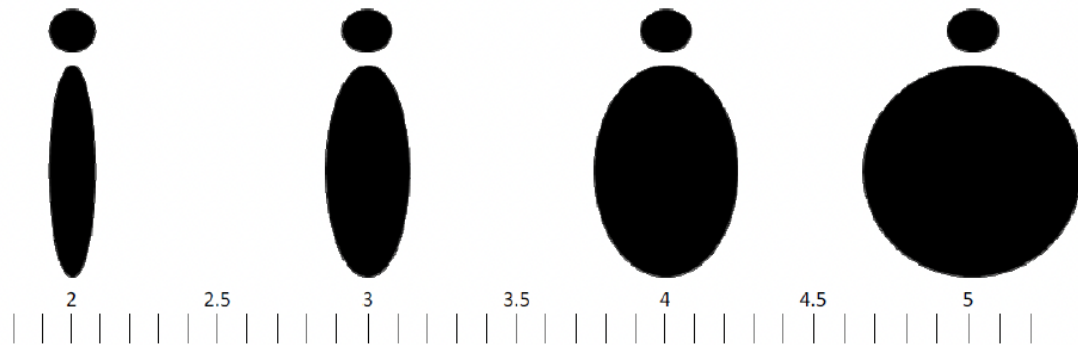
To evaluate body image dimensions, the Body Image Dimensional Assessment (BIDA) instrument was used. The BIDA was designed to measure the subjective and emotional dimensions of body image through a neutral, silhouette-based scale that is not specific to sex or ethnicity. The silhouette-based scale approach was chosen due to its effectiveness in minimizing biases from detailed and/or realistic images, focusing instead on basic body shape perceptions. Participants were

asked to select silhouettes that represented their perceived and ideal body shape, the body shape they believe is most prevalent among their peers, and the body shape they perceive as most attractive to the opposite sex. The scale offered a range of figures depicting different body shapes, extending from 1.8 to 5.2. Participants were not confined to selecting only the numerical values corresponding directly to images on the scale: they could also choose intermediate values for which representative images were not provided. Three direct indices were derived from the participants' responses:

- **BD:** This index represents a discrepancy between the participant's actual and ideal body image.
- **Sexual body dissatisfaction (SxBD):** This index indicates the difference between the participant's current body image and the body shape perceived as most attractive to the opposite sex.
- **Comparative body dissatisfaction (CBD):** This index measures the difference between the participant's current body image and the perceived body image of the majority of peers of the same sex and age.

These indices are computed based on the numerical differences between the chosen silhouettes, providing quantitative measures of body dissatisfaction dimensions. The primary objective of the BIDA is to determine the degree to which a participant's body image aligns with their desired body image. The three indices are expressed as percentages, ranging from -100% to +100%. Positive values indicate that the participant's actual rating is higher than desired, than what is perceived as sexually attractive, or than the average among peers. Conversely, negative values suggest a lower self-assessment. Furthermore, a composite score, the Body Dissatisfaction Index (BDI), was computed as an indirect measure. This index is the mean of the absolute values of BD, SxBD, and CBD, ranging from 0 to 100%. A BDI score exceeding 30% is considered indicative of a potential risk of body image disorders. The BIDA showed good reliability (standardized Cronbach's α coefficient = 0.881) in the nonclinical sample [57]. In Figure 3 was shown the BIDA instrument

Body Image Dimensional Assessment (BIDA)



With reference to the figures show above answer the following questions using the scale that ranges from 1,8 to 5,2.

1. What do you think you look like currently?
Answer: _____
2. Which is your ideal figure?
Answer: _____
3. Which is your ideal figure for the opposite sex?
Answer: _____
4. How do most people with your own sex and age look like?
Answer: _____

Figure 3. Body Image Dimensional Assessment instrument.

1.6. Exercise Dependence Scale-21

The adaptation of the 21-item Exercise Dependence Scale (EDS-21) was used to assess the level of dependency on exercise among the participants [58]. This questionnaire uses a 6-point Likert scale, where 1 indicates 'never' and 6 'always', to rate participants' exercise behaviors. The EDS-21 focuses on seven key aspects to determine the potential addiction to exercise:

- Withdrawal effects: This involves recognizing signs such as anxiety or fatigue that are typical when exercise is not performed or the need to maintain exercise intensity to avoid these symptoms.
- Continuance: This is the tendency to sustain exercise routines even in the face of ongoing psychological or physical problems, such as injuries.
- Tolerance: This reflects the requirement to progressively exercise more to achieve the same level of satisfaction or effect.
- Lack of control: This involves challenges faced in attempting to reduce or regulate the amount of exercise volume and/or intensity.
- Reduction in other activities: This is the inclination to limit social, work-related, or recreational activities in favor of exercise.
- Time: This is when a considerable amount of time is spent in preparing for, engaging in, or recovering from exercise.
- Intention effects: This is regularly performing more exercise than initially planned.

The identification of exercise dependence risk is based on achieving scores >14 in at least three of these seven dimensions. The overall score on the EDS-21 was computed by adding up the responses to all 21 questions [17,58]. The EDS-21 showed good psychometric characteristics (Cronbach's α coefficients: withdrawal effects = 0.79; continuance = 0.74, tolerance = 0.87; lack of control = 0.87; reduction in other activities = 0.70; time = 0.85 and intention effects = 0.89) [19]. In Figure 4 was shown the EDS-21.

EXERCISE DEPENDENCE SCALE-21

Using a scale from 1 (never) to 6 (always), please complete the following questions as honestly as possible. Questions refer to thoughts and behaviours about exercise in the last 3 months. There are no right or wrong answers. All responses are confidential. Indicate the number with which you identify yourself on the appropriate line.

1	2	3	4	5	6
NEVER					ALWAYS
1. I exercise to avoid feeling irritable _____					
2. I exercise despite recurring physical problems _____					
3. I continually increase my exercise intensity to achieve the desired effects/benefits _____					
4. I am unable to reduce how long I exercise _____					
5. I would rather exercise than spend time with family/friends _____					
6. I spend a lot of time exercising _____					
7. I exercise longer than I intend _____					
8. I exercise to avoid feeling anxious _____					
9. I exercise when injured _____					
10. I continually increase my exercise frequency to achieve the desired effects/benefits _____					
11. I am unable to reduce how often I exercise _____					
12. I think about exercise when I should be concentrating on school/work _____					
13. I spend most of my free time exercising _____					
14. I exercise longer than I expect _____					
15. I exercise to avoid feeling tense _____					
16. I exercise despite persistent physical problems _____					
17. I continually increase my exercise duration to achieve the desired effects/benefits _____					
18. I am unable to reduce how intense I exercise _____					
19. I choose to exercise so that I can get out of spending time with family/friends _____					
20. A great deal of my time is spent exercising _____					
21. exercise longer than I plan _____					

Figure 4. The 21-item Exercise Dependence Scale.

2. Phase 2: Eating Right, Sleeping Tight? A Cross-Sectional Study on the Student-Athlete Paradox for Diet and Sleep Behaviors

2.1 Participants

Twenty-eight female participants were recruited from the University of Cassino and Lazio Meridionale. The total sample was divided based on their athletic status. The student-athletes group consisted of volleyball players from the university's official team (n = 12), assessed during their in-season competitive period. The number of participants reflects the usual number of volleyball players on a team. Including an entire team ensured that participants had similar training schedules, competitive experience, and environmental conditions, reducing potential confounding factors that could arise from mixing athletes of different sports or performance levels. Since physical activity and sedentary behaviors are not the opposite of each other, individuals may meet recommended levels of physical activity and still accumulate high sitting time, which represents an independent risk factor for adverse health outcomes [59]. Moreover, sitting time (>5 h per day) has been used as the primary criterion to identify individuals with sedentary behaviors, independently of their physical activity levels, and the literature highlights its impact on health outcomes such as body image and exercise dependence, and has negative physiological effects [60]. For these reasons, the inclusion of participants in the peer group was independent of their actual levels of physical activity; non-athlete students (n = 16) with a high sitting time were included and assessed using the Italian short version (7 items) of the IPAQ [47].

2.2 PREvención con Dieta MEDiterránea

Data collection was carried out during a single supervised session using standardized procedures and dedicated questionnaires. The Italian version of the PREvención con Dieta MEDiterránea (PREDIMED) questionnaire was used to assess adherence to the Mediterranean diet [61]. PREDIMED is a 14-item questionnaire in which an adequate consumption of typical traditional Mediterranean foods and low consumption of foods that are not characteristic of the traditional Mediterranean diet results in one point. The PREDIMED score was calculated as the sum of all the points attributed to the items. Scores ranged from 0 (low adherence) to ≥ 10 (high adherence). Figure 5 shows the PREDIMED questionnaire.

14-item Questionnaire of Mediterranean diet adherence: PREDIMED

1. Do you use olive oil as main culinary fat?
 - a. Yes
 - b. Not
2. How much olive oil do you consume in a given day (including oil used for frying, salads, out-of-house meals etc.)?
 - a. <4 teaspoons
 - b. ≥4 teaspoons
3. How many vegetable servings do you consume per day? (1 serving : 200 g)
 - a. <2 servings
 - b. ≥2 servings
4. How many fruit units (including natural fruit juices) do you consume per day?
 - a. <3 servings
 - b. ≥3 servings
5. How many servings of red meat, hamburger, or meat products (ham, sausage, etc.) do you consume per day? (1 serving: 100–150 g)
 - a. <1 serving
 - b. ≥1 serving
6. How many servings of butter, margarine, or cream do you consume per day? (1 serving: 12 g)
 - a. <1 serving
 - b. ≥1 serving
7. How many sweet or carbonated beverages do you drink per day?
 - a. <1 serving
 - b. ≥1 serving
8. How much wine do you drink per week?
 - a. <7 glasses
 - b. ≥7 glasses
9. How many servings of legumes do you consume per week? (1 serving : 150 g)
 - a. <3 servings
 - b. ≥3 servings
10. How many servings of fish or shellfish do you consume per week? (1 serving 100–150 g of fish or 4–5 units or 200 g of shellfish)
 - a. <3 servings
 - b. ≥3 servings
11. How many times per week do you consume commercial sweets or pastries (not homemade), such as cakes, cookies, biscuits, or custard?
 - a. <3 servings
 - b. ≥3 servings
12. How many servings of nuts (including peanuts) do you consume per week? (1 serving 30 g)
 - a. <3 servings
 - b. ≥3 servings
13. Do you preferentially consume chicken, turkey, or rabbit meat instead of veal, pork, hamburger, or sausage?
 - a. Yes
 - b. Not
14. How many times per week do you consume vegetables, pasta, rice, or other dishes seasoned with sofrito (sauce made with tomato and onion, leek, or garlic and simmered with olive oil)?
 - a. <2 servings
 - b. ≥2 servings

Figure 5. PREvención con DIeta MEDiterránea questionnaire.

2.3 Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) evaluated subjective sleep quality and disturbances over the previous month. It includes 19 questions grouped into seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medications, and daytime dysfunction. Each component is scored on a scale from 0 to 3, with higher scores indicating greater dysfunction. A PSQI total score below 5 indicates good sleep quality, whereas scores ≥ 5 denote poor sleep quality [62]. Figure 6 shows the PSQI questionnaire.

PITTSBURGH SLEEP QUALITY INDEX

INSTRUCTIONS:
The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, what time have you usually gone to bed at night?

BED TIME _____
2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night?

NUMBER OF MINUTES _____
3. During the past month, what time have you usually gotten up in the morning?

GETTING UP TIME _____
4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)

HOURS OF SLEEP PER NIGHT _____

For each of the remaining questions, check the one best response. Please answer all questions.

<ol style="list-style-type: none"> a) Cannot get to sleep within 30 minutes <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> b) Wake up in the middle of the night or early morning <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> c) Have to get up to use the bathroom <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> d) Cannot breathe comfortably <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> e) Cough or snore loudly <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> 	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	<ol style="list-style-type: none"> f) Feel too cold <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> g) Feel too hot <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> h) Had bad dreams <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> i) Have pain <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> j) Other reason(s), please describe _____ <p>_____</p> <p>How often during the past month have you had trouble sleeping because of this? <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> </p> <ol style="list-style-type: none"> 6. During the past month, how would you rate your sleep quality overall? <table border="0" style="width: 100%;"> <tr> <td>Very good _____</td> </tr> <tr> <td>Fairly good _____</td> </tr> <tr> <td>Fairly bad _____</td> </tr> <tr> <td>Very bad _____</td> </tr> </table> 7. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")? <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> 8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity? <table border="0" style="width: 100%;"> <tr> <td>Not during the past month _____</td> <td>Less than once a week _____</td> <td>Once or twice a week _____</td> <td>Three or more times a week _____</td> </tr> </table> 9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done? <table border="0" style="width: 100%;"> <tr> <td>No problem at all _____</td> </tr> <tr> <td>Only a very slight problem _____</td> </tr> <tr> <td>Somewhat of a problem _____</td> </tr> <tr> <td>A very big problem _____</td> </tr> </table> 	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	Very good _____	Fairly good _____	Fairly bad _____	Very bad _____	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____	No problem at all _____	Only a very slight problem _____	Somewhat of a problem _____	A very big problem _____
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Figure 6. The Pittsburgh Sleep Quality Index questionnaire.

2.4 Morningness–Eveningness Questionnaire

The Morningness–Eveningness Questionnaire (MEQ) assessed individual preferences for the timing of daily activities. The questionnaire includes both Likert-type and time-based questions. Likert-type items offer four options, with lower scores indicating stronger evening preference. Time-based items are scored based on selected time intervals over a 7 h range, with all responses scored

from 1 to 5. The total score is the sum of all item scores and is used to classify chronotype into five categories: definitely morning type (70–86), moderately morning type (59–69), neither type (42–58), moderately evening type (31–41), and definitely evening type (16–30) [63]. Figure 7 shows the PSQI questionnaire.

MORNINGNESS-EVENINGNESS QUESTIONNAIRE
Self-Assessment Version (MEQ-SA)

For each question, please select the answer that best describes you by circling the answer that best indicates how you have felt in recent weeks.

- When would you get up if you were entirely free to plan your day?
 - 5:00 AM–6:30 AM (05:00–06:30 h)
 - 6:30 AM–7:45 AM (06:30–07:45 h)
 - 7:45 AM–9:45 AM (07:45–09:45 h)
 - 9:45 AM–11:00 AM (09:45–11:00 h)
 - 11:00 AM–12:00 AM (11:00–12:00 h)
- What time would you go to bed if you were entirely free to plan your evening?
 - 8:00 PM–9:00 PM (20:00–21:00 h)
 - 9:00 PM–10:15 PM (21:00–22:15 h)
 - 10:15 PM–12:30 AM (22:15–00:30 h)
 - 12:30 AM–1:45 AM (00:30–01:45 h)
 - 1:45 AM–3:00 AM (01:45–03:00 h)
- If you usually have to get up at a specific time in the morning, how much do you depend on an alarm clock?
 - Not at all
 - Slightly
 - Somewhat
 - Very much
- How easy do you find it to get up in the morning when you are not awakened unexpectedly?
 - Very difficult
 - Somewhat difficult
 - Fairly easy
 - Very easy
- How alert do you feel during the first half hour after you wake up in the morning?
 - Not at all alert
 - Slightly alert
 - Fairly alert
 - Very alert
- How hungry do you feel during the first half hour after you wake up?
 - Not at all hungry
 - Slightly hungry
 - Fairly hungry
 - Very hungry
- During the first half hour after you wake up in the morning, how do you feel?
 - Very tired
 - Fairly tired
 - Fairly refreshed
 - Very refreshed
- If you had no commitments the next day, what time would you go to bed compared to your usual bedtime?
 - Seldom or never later
 - Less than 1 hour later
 - 1–2 hours later
 - More than 2 hours later
- You have decided to exercise. A friend suggests that you do this for one hour, twice a week, between 7–8 AM (07–08 h). Bearing in mind nothing but your own internal “clock,” how do you think you would perform?
 - Would be in good form
 - Would be in reasonable form
 - Would find it difficult
 - Would find it very difficult
- When would you go to bed if you could sleep when you felt like it?
 - 8:00 PM–9:00 PM (20:00–21:00 h)
 - 9:00 PM–10:15 PM (21:00–22:15 h)
 - 10:15 PM–12:45 AM (22:15–00:45 h)
 - 12:45 AM–2:00 AM (00:45–02:00 h)
 - 2:00 AM–3:00 AM (02:00–03:00 h)
- You want to be at your peak performance for a test that you know is going to be mentally exhausting and will last two hours. You are entirely free to plan your day. Considering only your “internal clock,” which one of the four testing times would you choose?
 - 8 AM–10 AM (08–10 h)
 - 11 AM–1 PM (11–13 h)
 - 3 PM–5 PM (15–17 h)
 - 7 PM–9 PM (19–21 h)
- If you went to bed at 11 PM (23 h), how tired would you be?
 - Not at all tired
 - A little tired
 - Fairly tired
 - Very tired
- For some reason you have gone to bed several hours later than usual, but there is no need to get up at any particular time the next morning. Which one of the following are you most likely to do?
 - Wake up at your usual time, but not fall back asleep
 - Wake up at your usual time, and doze thereafter
 - Wake up at your usual time, but fall asleep again
 - Not wake up until later than usual
- One night you have to remain awake between 4–6 AM (04–06 h) to carry out a night watch. You have no time commitments the next day. Which one of these alternatives would suit you best?
 - Stay up until the watch is over
 - Take a nap before the watch, and sleep after
 - Have a good sleep before the watch, and nap after
 - Sleep only before the watch
- You have two hours of hard physical work. You are entirely free to plan your day. Considering only your internal “clock,” which of the following times would you choose?
 - 8 AM–10 AM (08–10 h)
 - 11 AM–1 PM (11–13 h)
 - 3 PM–5 PM (15–17 h)
 - 7 PM–9 PM (19–21 h)
- You have decided to exercise. A friend suggests that you do this for one hour twice a week between 10–11 PM (22–23 h). Bearing in mind only your internal “clock,” how well do you think you would perform?
 - Would be in good form
 - Would be in reasonable form
 - Would find it difficult
 - Would find it very difficult
- Suppose that you can choose your own work hours. Assume that you work a five-hour day (including breaks), your job is interesting, and you are paid based on your performance. At approximately what time would you choose to begin?
 - 5 hours starting between 4–8 AM (04–08 h)
 - 5 hours starting between 8–9 AM (08–09 h)
 - 5 hours starting between 9 AM–2 PM (09–14 h)
 - 5 hours starting between 2–5 PM (14–17 h)
 - 5 hours starting between 5 PM–4 AM (17–04 h)
- At approximately what time of day do you usually feel your best?
 - 5–8 AM (05–08 h)
 - 8–10 AM (08–10 h)
 - 10 AM–5 PM (10–17 h)
 - 5–10 PM (17–22 h)
 - 10 PM–5 AM (22–05 h)
- Are you a “morning type” or an “evening type”?
 - Definitely a morning type
 - Rather more a morning type than an evening type
 - Rather more an evening type than a morning type
 - Definitely an evening type

Figure 7. The English version of the Morningness–Eveningness Questionnaire (MEQ).

Lastly, body dissatisfaction was evaluated using the Italian-adapted BIDA [57].

3. Phase 3: Sleep Quality and Adherence to the Mediterranean Diet in Male Young Adults: Insights from Amateur Soccer Players, Physically Active and Sedentary Individuals

3.1 Participants

Participant recruitment and data collection were conducted between March and May 2023, with participants volunteering and receiving no financial or material incentives. All questionnaires were completed on a training day, prior to the start of the training session, to avoid the acute effects of exercise on sleep responses. Twenty male soccer players were recruited from a regional-level amateur soccer team officially affiliated with the Italian Football Federation. All players regularly participated in structured team training sessions three times per week, each lasting approximately 90 minutes, in addition to one official match per week. Training sessions were typically scheduled in the evening, starting at 19:00. The sample size reflects the typical number of players in a soccer team. Recruiting an entire team ensured homogeneity in training schedules, competitive experience, and environmental conditions, thereby reducing potential confounding factors related to differences in sport discipline or performance level. Participants were required to have a minimum of four years of continuous soccer practice at the amateur level and to be actively engaged in both training and competition at the time of the study. Players were excluded if they reported any injury or medical condition that prevented full participation in training sessions or official matches. These criteria were adopted to ensure a stable training background and increase sample homogeneity. However, given the sample size, the present study should be considered exploratory. The recruitment and data collection of soccer players took place during the competitive season. Training sessions were conducted on weekdays, whereas official matches were typically played on weekends, and travel-related demands were not a factor during the weekdays.

To allow peer comparisons, eighteen physically active individuals and seventeen individuals with high sitting time were recruited from the university population. Physical activity levels and high sitting time behavior were assessed using the Italian short version (7 items) of the IPAQ [47]. Physically active individuals were classified as health-enhancing physical activity (HEPA) active

according to established IPAQ criteria [47]. All participants in this group reported engaging in structured fitness-based physical activity three times per week, with each session lasting approximately 90 minutes. Training sessions were typically performed in the university gym facilities and scheduled in the late afternoon, after university lectures, at approximately 18:00. Individuals with high sitting time were identified primarily based on daily sitting time, assessed using the sitting item of the IPAQ, reporting the time spent sitting on a weekday during the previous seven days, including time spent at work, at home, during coursework, and leisure activities [47]. Accordingly, the high sitting group included participants who reported sitting for five or more hours per day. This classification allowed the distinction between individuals engaged in regular, structured physical activity and those characterized by high sitting time, enabling the investigation of sleep quality, dietary adherence, and chronotype across different habitual activity profiles. The sitting time for individuals with high sitting time behavior and physically active individuals was 7.0 ± 2.1 and 2.6 ± 0.8 hours per day, respectively.

3.2 Procedures

During the session, participants were asked to complete a total of three questionnaires: the PSQI, PREDIMED, and the MEQ. All questionnaires were administered in a quiet environment to reduce distraction and improve response accuracy. The total time to complete the questionnaires was approximately 20 minutes.

Article

Effect of Physical Activity Behaviors, Team Sports, and Sitting Time on Body Image and Exercise Dependence

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Article

Effect of Physical Activity Behaviors, Team Sports, and Sitting Time on Body Image and Exercise Dependence

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Abstract: This study aimed to evaluate whether the type and degree of physical activity commitment (i.e., team sport athletes, highly active individuals, sedentary behavior) influence body image and exercise behavior. A total of 96 participants (46 women and 50 men; age: 22.7 ± 2.7 years; height: 170 ± 8.6 cm; weight: 67.6 ± 10.8 kg) were divided in six groups: female volleyball and male football players (student athletes classified as Tier 2), highly physically active women and men, with high sitting time completed the Body Image Dimensional Assessment and the 21-item Exercise Dependence Scale to evaluate body dissatisfaction and level of dependency on exercise. The Body Image Dimensional Assessment is a silhouette-based scale, where three direct indices are derived from the participants' responses: body dissatisfaction, sexual body dissatisfaction, and comparative body dissatisfaction. The Exercise Dependence Scale is a six-point Likert scale that evaluates seven dimensions of exercise dependence (tolerance, withdrawal, intention effects, lack of control, time, reductions in other activities, and continuance) and provides an overall score. A multivariate analysis of variance was used to examine the effects of different levels of physical activity, team sport participation (volleyball and football), and sedentary behavior (i.e., high sitting time) on participants' body image indices and dimensions of exercise dependence according to sex. Volleyball players showed significantly higher body dissatisfaction than football players ($d = 0.99$) and the physically active men group ($d = 2.31$), who had lower values than sedentary women group ($d = 1.68$). Football players had lower comparative body dissatisfaction values than volleyball players ($d = 1.70$) and sedentary women ($d = 1.69$), who had higher values than sedentary men ($d = 1.04$). Sedentary women had a significantly lower exercise dependence scale score than volleyball players ($d = 1.71$), football players ($d = 1.12$), and physically active men ($d = 1.21$). The findings highlight the impact of regular physical activity on body dissatisfaction and the variance in body image perceptions between the sexes. Moreover, the high exercise dependence values found in volleyball and football players and physically active men suggest an effect of intense training and maladaptive exercise behaviors, underlining the need for comprehensive strategies to address exercise dependence.

Keywords: body perception; exercise addiction; team sport; student athletes; sitting duration; volleyball; football; IPAQ



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1. Introduction

The World Health Organization (WHO) defines mental health as a state of mental well-being that enables people to cope with the stresses of life, realize their goals, work productively, and contribute to their community [1]. This definition is reflected by the individual's perception of their position in life, goals, expectations, standards, and concerns, defined as quality of life (QoL) [1]. Mental health is fundamental to well-being, and mental

disorders are real health conditions, given their contribution to morbidity, premature mortality, and decreasing QoL [1]. To promote mental health, it is necessary to address negative health behaviors such as smoking, diet, alcohol consumption, and sedentary behaviors, such as long periods spent sitting [1–3].

Physical activity (PA) plays a key role in enhancing mental health. Engaging in regular PA, exercise (i.e., a subcategory of PA that is planned, structured, repetitive, and purposeful, aiming at the improvement in or maintenance of one or more components of physical fitness), or sports (i.e., a range of activities performed within a set of rules and undertaken as part of leisure or competition) [4] has been demonstrated to have a positive influence on mental health by reducing anxiety, depression, negative mood, and by improving confidence [5,6]. Exercise could also promote improvements in self-efficacy, as well as objective and perceived physical fitness (i.e., body composition, cardiorespiratory endurance, and muscular strength), all of which lead to improvements in body image [7,8]. Body image is a multidimensional construct that encompasses a behavioral aspect linked to body-related behaviors (e.g., checking behaviors), a perceptual aspect linked to the perception of body characteristics (e.g., estimation of one's body size or weight), and a cognitive-affective aspect involving thoughts and feelings toward one's body [7–10]. The contribution of exercise to improvements in body image might be attributed to the fact that individuals who engage in regular PA more closely resemble the aesthetic ideal of a lean and fit physique for women and a lean and muscular physique for men with respect to nonexercisers. The effect of exercise or sport on body image may also be due to the fact that PA participation is associated with an increase in psychological well-being that is related to a positive body image [11]. Negative thoughts, behaviors, perceptions, and feelings about one's body are defined as body dissatisfaction (BD) [9,10,12], referring to the extent to which individuals are dissatisfied with their bodies, which has a significant impact on mental health. Sociocultural pressure regarding unrealistic ideals of beauty could lead to negative comparisons and a constant sense of inadequacy regarding one's body, generating low self-esteem, anxiety, depression, and eating disorders [10,12–14]. This connection highlights the importance of addressing body image to foster mental health and prevent mental health issues and eating disorders.

In the sports and exercise context, positive body image is influenced by tangible physiological modifications, such as improvement in body composition, attributed to the sport practiced (individual vs. team sports), the individual's perception of their physical changes, and the development of self-assurance and self-efficacy [8,15–17]. Although studies [8,15–17] have shown the benefits of sports on body image, athletes can experience BD due to the demands of their sport. In particular, some sports prioritize specific body types or unique attributes, and athletes may feel pressure to conform to these idealized body types, even if it means sacrificing their health or well-being. In individual sports, successful achievement depends on the success of the performance of the individual; so, some sports focusing on physical appearance and aesthetics (gymnastics, figure skating, etc.), and with certain weight classes (wrestling, boxing, etc.) could predispose the athlete to developing BD [18]. In team sports, performance-related tasks are shared among teammates, and success is determined by the individual achievement of each athlete [16], not only on their appearance. Furthermore, women tend to exhibit greater BD than their male counterparts [10,19]. Therefore, the role of sex in the relationship between body image and exercise or sport needs further study because the sex differences in the social ideals regarding one's own body could have different influences the relationship between exercise or sport and body image [10,19].

BD may lead to exercise addiction, which can also result in decreased performance due to overload and physical burnout [8,15,20]. Despite studies showing how exercise and sport are beneficial for both psychological and physical health, there is a general consensus that excessive exercise may lead to addictive inclinations [21–23], such as dependence, characterized by a compulsion to train, resulting in uncontrollable excessive exercise behavior. This results in physiological and psychological symptoms that could have a

negative impact on mental health, such as depression and anxiety [23]. Individuals who exercise frequently may feel unable to reduce their exercise; continue despite illness, injury, and social conflict; and experience “withdrawal symptoms” when forced to stop [23,24]. With BD, there are sex differences in exercise dependence, where men generally are at higher risk of developing maladaptive exercise behavior than women [25], given the greater motivation to exercise and increase the amount and intensity of training [25–27]. So, it is important to consider the role of sex in exercise dependence.

Because exercise has a positive effect on physical appearance, one of the reasons for exercise dependence is improving body image. Individuals exercise with the aim of enhancing fitness levels and achieving a desired physique, leading in turn to an increased risk of exercise dependence [28]. Athletes can also experience exercise addiction due to an obsession with achieving top performance and results [28]. Moreover, different sports elicit different physical, psychological, and social demands, all of which can significantly influence both self-perception and exercise-related behaviors [15]. Among the team sports, football and volleyball are the most popular within the Italian young adult population [29]. Therefore, this population could offer an accurate representation of the actual situation, providing useful information regarding body image and exercise dependence.

With sports being widely followed and practiced in Italy, football and volleyball players may experience strong television and social media exposure, influencing expectations and social pressures regarding body image and commitment to training, in particular in professional and college athletes [30–32]. Given the complex link between PA, perception of one’s own body, and excessive exercise [15,21,33], there is a need for an in-depth investigation that examines these dynamics in populations with different PA behaviors. Therefore, the aim of this study was to examine the effect of lifestyle, including team sport participation (i.e., football and volleyball), PA engagement level, and sitting time, and their effect on body image and exercise dependence according to sex. We hypothesized that team sport athletes, individuals with high levels of PA, and individuals with high sitting time significantly differ regarding BD, considering differences between the sexes, and that participants with high levels of PA and team sport athletes would show more exercise dependence than physically active individuals with long sitting time.

2. Materials and Methods

2.1. Study Design

In adherence to the Declaration of Helsinki, the research protocol, designed as a cross-sectional study, was approved on 8 March 2023 by the Institutional Review Board of the Department of Human Sciences, Society and Health at the University of Cassino and Lazio Meridionale (approval Number 9407) to examine the effects of team sport participation, PA engagement levels, and sitting time on BD and exercise dependence among university students. This cross-sectional study was conducted in the Sport and Exercise Physiology Laboratory of the University of Cassino and Lazio Meridionale, where all data were collected at a specific point in time, without any longitudinal follow-up. Data collection was conducted in the afternoon. The hour of data collection was chosen to accommodate the students’ and student athletes’ schedules, as they were free from training and university lectures at this time, ensuring their availability and minimizing conflicts with their academic and sport commitments. All participants provided informed consent and were informed of their right to withdraw from this study at any time and for any reason. The inclusion criteria were clearly defined to select student athletes who engaged in team sports, students regularly participating in PA, or with long sitting time. After the recruitment and selection process of the participants, the individuals’ body image and exercise dependence were evaluated.

2.2. Participants

Young adults were recruited among the student and student athlete population of the University of Cassino and Lazio Meridionale. To ensure that our study was robustly

powered to detect substantial effects, we sought an effect size (ES) of 1.2, indicative of a very large impact by Cohen's standards, to reflect our commitment to identifying only the most meaningful significant differences. The rationale behind targeting such a marked ES was from the existing literature [21], focusing on the relationship between PA and health perception. In particular, targeting an alpha of 0.05 and a power of 0.80 across 6 distinct groups, our power analysis demonstrated that a sample size of approximately 16 participants per group was required for obtaining an ES of 1.2. As highlighted by Schweizer and Furley [34], a large ES was chosen because smaller samples have a higher likelihood of producing type II error (i.e., not yielding a significant test although the effect exists). Moreover, small samples make replication attempts particularly difficult. This may mean that the effect does not exist or that the study did not have enough power to detect it. For these reasons, a power of 0.80 and a large ES (1.2) was chosen. A convenience sampling method was used to recruit participants from the university population by means of flyers, posters, brochures, and advertisements on social network. To avoid the influence of age in our evaluation, only participants in the young adult category (aged between 18 and 35 years) were recruited. After the recruitment and selection processes, different groups were divided based on their athletic and nonathletic status and sex: male football players and female volleyball players, highly physically active men and women, and men and women with long sitting time.

2.3. Measures

The Italian short version (7 items) of the International Physical Activity Questionnaire (IPAQ) was administered to the participants to evaluate the individual PA levels and sitting time. The IPAQ (Cronbach's α coefficient of 0.60 [35]) comprises 7 items that evaluate the frequency, intensity, and duration of PA at various levels: low (such as walking), moderate, and vigorous, along with total PA per week. Additionally, it includes an item regarding daily sitting time to estimate sedentary lifestyle patterns. The IPAQ includes both categorical and continuous scores. The categorical scores classify participants into three levels: inactive, minimally active, and health-enhancing physical activity (HEPA) active, which denotes activity levels that exceed the minimum public health PA recommendations, which are associated with enhanced health benefits [35,36]. The continuous scores are calculated in metabolic equivalent of task (MET) minutes per week.

To classify people according to the sports practiced, the participants were asked: "Do you currently have any injuries that prevent you from training or exercise? Do you practice any sports? If yes, please specify which sport and for how long." In fact, engaging in structured and regular training and competition exceeding the suggested [37,38] minimum amount of PA to obtain health benefits (i.e., exercising for more than 300 min per week at moderate intensity or 150 min per week exercises at vigorous intensity) could be beneficial for improving mental health among adults. Team sports in particular may provide even more powerful and additional benefits [39] due to the required intermittent physical exercise, high cognitive-attention demands, and problem-solving skills under time pressure [40]. Since sedentary behavior increases the risks of heart and metabolic diseases and the prevalence of psychological distress in adults, independent of the protective effect of leisure-time PA [41], it is crucial to consider the impact of long sitting time (>5 h per day) on mental and physical health [42-44]. Therefore, sitting time was used as indicator of sedentary behavior [45].

2.4. Procedures

From a total of 140 participants (Figure 1), 20 were excluded because they did not fully complete the questionnaires. The remaining 120 participants were allocated according to their athletic status. If the participants reported practicing sports, they were allocated to the athletic students group, and the following inclusion criteria were applied: (i) student athletes engaged in the most popular Italian sports for their respective sexes [29], being football for men and volleyball for women; (ii) team sport training and competition for at

least the previous 4 years. Participants were excluded if they had an injury that prevented them from training and competition or they practiced team sport for less than 4 years. From the 40 participants allocated to the athletic students' group, 9 were excluded because of not meeting the inclusion criteria, while 31 were allocated to the football players' group ($n = 17$) and volleyball players' group ($n = 14$). These inclusion and exclusion criteria were chosen to ensure that the student athletes had substantial and consistent experience in their respective sports to avoid the impact of variables such as injury or insufficient training duration on the evaluation. Participants included in the football and volleyball players' groups reported training on average for three 2 h sessions plus a competitive match per week. In accordance with the 6-tiered Participant Classification Framework [46], football and volleyball players were classified as Tier 2, corresponding to individuals engaging in sport-specific training approximately three times a week with the intention to compete at the local level.

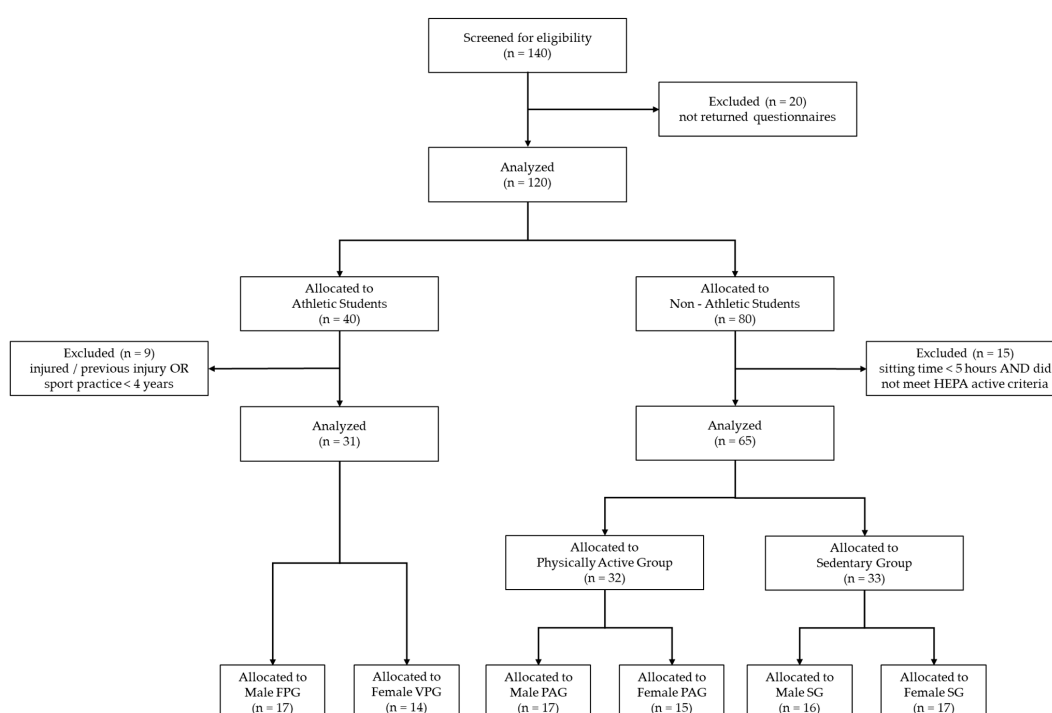


Figure 1. Flow chart of the recruitment and selection process of the participants included in the study. FPG = football players' group, VPG = volleyball players' group; PAG = physically active group; SG = sedentary group, HEPA = health-enhancing physical activity.

If participants did not report practicing sport, they were allocated to the nonathletic students and based on the IPAQ responses; the following inclusion criteria were applied: (i) students classified as HEPA active, or (ii) students that reported sitting for 5 or more hours in total per day. Nonathletic students were excluded if they reported less than 5 h per day of sitting time while not meeting the criteria to be classified as HEPA active. From the 80 participants allocated to the nonathletic students group, 15 were excluded because of not meeting the inclusion criteria. Therefore, the 65 participants from the nonathletic students group were included and allocated to the physically active group (physically active men group: $n = 17$; physically active women group: $n = 15$) and sedentary group (sedentary men group: $n = 16$; sedentary women group: $n = 17$). The physically active group included

participants who met one of two criteria to be classified as HEPA active: either engaging in vigorous-intensity activity on at least 3 days per week, achieving a minimum of 1500 MET minutes per week; or participating in any combination of walking, moderate-intensity, or vigorous-intensity activities totaling at least 3000 MET minutes per week [35,36]. The sedentary group included individuals who reported sitting for 5 or more hours in total each day. The inclusion of participants in the sedentary group was independent of their actual levels of PA, whether inactive, minimally active, or HEPA active. This approach acknowledges that even individuals who engage in regular PA can still lead a largely sedentary lifestyle. The categorization in the sedentary group was based solely on the amount of time spent sitting, reflecting a lifestyle with minimal physical movement or exertion. The long sitting time in this group corresponds to an energy expenditure ranging from 1.0 to 1.5 METs, which is characteristic of sedentary behavior [36,44,47]. The threshold of 5 or more hours of sitting per day was selected based on the literature [44,45,47] that has identifies this time as the critical point having impacts on health outcomes such as increased risks of mortality, metabolic syndrome, and cardiovascular diseases and having negative psychological effects.

Before starting the experimental session, participants' anthropometric characteristics were collected. Body mass (kg) and height (m) measurements were recorded using a Seca 709 scale equipped with an integrated stadiometer, with precision up to 0.1 kg for weight and 0.1 cm for height (Vogel & Halke, Hamburg, Germany). Body mass index (BMI) was calculated using the formula of weight in kilograms (kg) divided by the square of height in meters (m²). All participants were classified as young adults (aged between 18 and 35 years) [48] and had a BMI within the normal range (18.5–24.9 kg/m²). The characteristics of the participants are presented in Table 1.

Table 1. Means and standard deviations of the participants' anthropometric characteristics.

	FPG	VPG	MPAG	FPAG	MSG	FSG
Age (years)	22.0 ± 3.4	22.0 ± 2.3	22.5 ± 3.5	22.4 ± 2.1	23.7 ± 1.9	23.5 ± 2.7
Body mass (kg)	67.3 ± 8.3	63.6 ± 7.7	73.5 ± 8.5	58.6 ± 7.5	76.8 ± 13.3	64.7 ± 8.2
Body height (cm)	171.9 ± 8.0	167.5 ± 7.2	175.9 ± 4.5	164.6 ± 4.4	178.1 ± 10.0	165.1 ± 6.1
BMI (kg·m ⁻²)	22.7 ± 2.5	22.6 ± 2.2	23.7 ± 2.0	21.6 ± 2.7	24 ± 2.1	23.7 ± 2.8

BMI = body mass index; FPG = football players' group; VPG = volleyball players' group; MPAG = physically active men's group; FPAG = physically active women's group; MSG = sedentary men's group; FSG = sedentary women's group.

The data collection (around 30 min) was individually carried out under supervision of doctoral and trainee masters students in preventive and adaptive physical activity of the University of Cassino and Lazio Meridionale. Participants completed the Body Image Dimensional Assessment (BIDA) instrument and the 21-item Exercise Dependence Scale (EDS-21), described in detail in Section 2.5. The timeline of the procedures is shown in Figure 2.

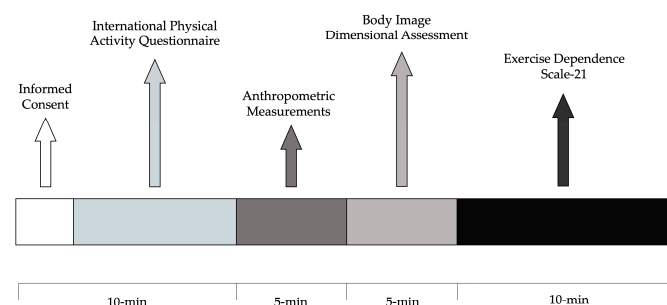


Figure 2. Timeline of the experimental procedures.

2.5. Instruments

2.5.1. Body Image Dimensional Assessment

The BIDA instrument adapted to Italian [21,49] was used to evaluate participants' BD in relation to their body size. The BIDA was designed to measure the subjective and emotional dimensions of body image through a neutral, silhouette-based scale that is not specific to sex or ethnicity. The silhouette-based scale approach was chosen due to its effectiveness in minimizing biases from detailed and/or realistic images, focusing instead on basic body shape perceptions. Participants were asked to select silhouettes that represented their perceived and ideal body shape, the body shape they believe is most prevalent among their peers, and the body shape they perceive as most attractive to the opposite sex. The scale offered a range of figures depicting different body shapes, extending from 1.8 to 5.2. Participants were not confined to selecting only the numerical values corresponding directly to images on the scale: they could also choose intermediate values for which representative images were not provided. Three direct indices were derived from the participants' responses:

- BD: This index represents a discrepancy between the participant's actual and ideal body image.
- Sexual body dissatisfaction (SxBD): This index indicates the difference between the participant's current body image and the body shape perceived as most attractive to the opposite sex.
- Comparative body dissatisfaction (CBD): This index measures the difference between the participant's current body image and the perceived body image of the majority of peers of the same sex and age.

These indices are computed based on the numerical differences between the chosen silhouettes, providing quantitative measures of body dissatisfaction dimensions. The primary objective of the BIDA is to determine the degree to which a participant's body image aligns with their desired body image. The three indices are expressed as percentages, ranging from -100% to $+100\%$. Positive values indicate that the participant's actual rating is higher than desired, than what is perceived as sexually attractive, or than the average among peers. Conversely, negative values suggest a lower self-assessment. Furthermore, a composite score, the Body Dissatisfaction Index (BDI), was computed as an indirect measure. This index is the mean of the absolute values of BD, SxBD, and CBD, ranging from 0 to 100%. A BDI score exceeding 30% is considered indicative of a potential risk of body image disorders. The BIDA showed good reliability (standardized Cronbach's α coefficient = 0.881) in the nonclinical sample [49].

2.5.2. Exercise Dependence Scale-21

The adaptation of the 21-item Exercise Dependence Scale (EDS-21) to Italian was used to assess the level of dependency on exercise among the participants [21,50]. This questionnaire uses a 6-point Likert scale, where 1 indicates 'never' and 6 'always', to rate participants' exercise behaviors. The EDS-21 focuses on seven key aspects to determine the potential addiction to exercise:

1. Withdrawal effects: This involves recognizing signs such as anxiety or fatigue that are typical when exercise is not performed or the need to maintain exercise intensity to avoid these symptoms.
2. Continuance: This is the tendency to sustain exercise routines even in the face of ongoing psychological or physical problems, such as injuries.
3. Tolerance: This reflects the requirement to progressively exercise more to achieve the same level of satisfaction or effect.
4. Lack of control: This involves challenges faced in attempting to reduce or regulate the amount of exercise volume and/or intensity.
5. Reduction in other activities: This is the inclination to limit social, work-related, or recreational activities in favor of exercise.

6. Time: This is when a considerable amount of time is spent in preparing for, engaging in, or recovering from exercise.
7. Intention effects: This is regularly performing more exercise than initially planned.

The identification of exercise dependence risk is based on achieving scores >14 in at least three of these seven dimensions. The overall score on the EDS-21 was computed by adding up the responses to all 21 questions [51]. The EDS-21 showed good psychometric characteristics (Cronbach's α coefficients: withdrawal effects = 0.79; continuance = 0.74, tolerance = 0.87; lack of control = 0.87; reduction in other activities = 0.70; time = 0.85 and intention effects = 0.89) [50].

2.6. Statistical Analysis

STATA software version 14.2 (StataCorp, College Station, TX, USA) was used for statistical analysis. The Shapiro–Wilk test was employed to assess the normal distribution of the data. Means, standard deviations (SDs), and 95% confidence intervals (95% CIs) for continuous variables and frequencies and percentages for categorical variables were calculated. Internal consistency reliability of BIDA and EDS-21 was tested using Cronbach's α coefficient.

One-way ANOVAs were used to examine IPAQ, BDI, and EDS score differences between PA groups (football players' group, volleyball players' group, physically active men, physically active women, sedentary men, and sedentary women). A multivariate analysis of variance (MANOVA) was used to examine the effects of different PA groups on participants' body image indices (BD, SxBD, CBD) and exercise dependence (tolerance, withdrawal, intention effects, lack of control, time, reductions in other activities, continuance), separately.

The ES was calculated and is expressed as Cohen's d and eta squared (η^2) to determine the magnitude of the effects. The following criteria were used for the interpretation of Cohen's d : small = 0.20, medium = 0.50, and large = 0.80. The thresholds for considering effects as small, medium, or large were values of η^2 of 0.01, 0.06, and 0.14. For all the analyses, when significant main effects ($p < 0.05$) were found, Bonferroni correction was applied with a resulting p -value set at 0.003, and subsequently unpaired t -tests were performed across groups.

3. Results

The BIDA showed good internal consistency reliability, with a Cronbach's α coefficient = 0.72 for the test scale based on all items. For single items, Cronbach's α was 0.66 for BD, 0.53 for SxBD, and 0.70 for CBD. The EDS-21 showed an excellent reliability, with a Cronbach's α = 0.84 for the test scale based on all items. For single items, Cronbach's α was 0.83 for withdrawal effects, 0.85 for continuance, 0.82 for tolerance, 0.80 for lack of control, 0.82 for reduction in other activities, 0.81 for time and 0.82 for intention effects.

Based on the IPAQ score, all groups were minimally active (at least 150 min of moderate-intensity exercise or at least 60 min of vigorous-intensity exercise or 600 total METs per week) achieving the HEPA active category, except for the sedentary women's group [36]. The results of the one-way ANOVA showed significant differences among the groups across several variables of the IPAQ scores (Table 2), including sitting time ($F_{(5, 90)} = 28.77$; $p < 0.0001$; $\eta^2 = 0.65$), vigorous METs ($F_{(5, 90)} = 8.80$; $p < 0.0001$; $\eta^2 = 0.32$), moderate MET ($F_{(5, 90)} = 4.16$; $p = 0.0019$; $\eta^2 = 0.18$), and total METs ($F_{(5, 90)} = 6.56$; $p < 0.0001$; $\eta^2 = 0.26$). Post hoc analyses with Bonferroni adjustments indicated that sedentary men and sedentary women exhibited significantly longer sitting time ($p < 0.001$ for both) compared to the other groups (football players' group, volleyball players' group, physically active men, physically active women). In terms of vigorous METs and total METs, both the physically active men and physically active women demonstrated significant differences from the other groups (football players' group, sedentary men, sedentary women), with p -values of less than 0.003 and 0.001, respectively.

Table 2. Means and standard deviations of the IPAQ scores.

	FPG	VPG	MPAG	FPAG	MSG	FSG
Sitting (hour/day)	2.6 ± 1.7	3.0 ± 2.0	1.9 ± 0.6	2.1 ± 0.8	6.5 ± 1.7	7.0 ± 2.5
W-MET (min/week)	639.6 ± 771.0	556.2 ± 340.4	970.5 ± 1179.5	1244.1 ± 1162.0	925.8 ± 1368.3	1565.5 ± 1131.1
M-MET (min/week)	763.5 ± 858.4	1322.8 ± 911.9	824.7 ± 902.3	920.0 ± 782.5	476.2 ± 408.9	211.7 ± 344.0
V-MET (min/week)	1736.4 ± 1523.8	2800.0 ± 1927.9	3971.7 ± 1331.2	4032.0 ± 2911.5	1545.0 ± 1463.1	943.5 ± 1107.1
T-MET (min/week)	3139.6 ± 2409.3	4679.1 ± 2472.5	5767.0 ± 2346.4	6196.1 ± 3517.9	2947.1 ± 1597.9	2720.8 ± 1563.0

W-MET = walking metabolic equivalent of task; M-MET = moderate metabolic equivalent of task; V-MET = vigorous metabolic equivalent of task; T-MET = total metabolic equivalent of task; FPG = football players' group, VPG = volleyball players' group; MPAG = physically active men's group; FPAG = physically active women's group; MSG = sedentary men's group; FSG = sedentary women's group.

Regarding the participants' body image (Table 3), the MANOVA results revealed a significant multivariate effect of PA level on the combined body image indices (BD, SxBD, CBD) (Wilks' Lambda = 0.5726; $F_{(15, 243.3)} = 3.63$; $p < 0.0001$; $\eta^2 = 0.17$; 95% CI = 0.02 to 0.27). Follow-up one-way ANOVA indicated significant effects of PA level on BD ($F_{(5, 90)} = 5.16$; $p = 0.0003$; $\eta^2 = 0.22$) and CBD ($F_{(5, 90)} = 6.39$; $p < 0.0001$; $\eta^2 = 0.26$). Subsequent to Bonferroni adjustments for multiple comparisons, significant differences emerged in the BD between the football players' group and volleyball players' group ($p = 0.001$; 95% CI = 6.27 to 24.07; $t = 3.39$; SE = 4.48; $d = 0.99$), between the physically active men and volleyball players ($p < 0.001$; 95% CI = −28.74 to −10.94; $t = -4.43$; SE = 4.48; $d = 2.31$), and between the physically active men and sedentary women ($p = 0.001$; 95% CI = −23.51 to −6.59; $t = -3.53$; SE = 4.25; $d = 1.68$).

Table 3. Means and standard deviations of body image indices.

	FPG	VPG	MPAG	FPAG	MSG	FSG
BD (%)	1.2 ± 19.4	16.4 ± 9.4	−3.4 ± 7.6	4.5 ± 9.8	5.7 ± 13.5	11.6 ± 10.1
SxBD (%)	−0.2 ± 21.0	11.9 ± 15.3	0.2 ± 11.3	2.9 ± 14.6	7.5 ± 16.4	9.1 ± 12.4
CBD (%)	−14.3 ± 11.7	7.9 ± 14.3	3.1 ± 18.7	3.1 ± 14.2	−4.7 ± 17.4	16.1 ± 22.4
BDI (%)	14.9 ± 6.1	14.2 ± 9.4	10.5 ± 5.1	10.3 ± 5.7	12.7 ± 6.7	15.2 ± 8.3

BD = body dissatisfaction; SxBD = sexual body dissatisfaction; CBD = comparative body dissatisfaction; BDI = Body Dissatisfaction Index; FPG = football players' group, VPG = volleyball players' group; MPAG = physically active men's group; FPAG = physically active women's group; MSG = sedentary men's group; FSG = sedentary women's group.

In terms of CBD, after accounting for multiple comparisons, the football players' group showed significant differences when compared to both the volleyball players' group ($p < 0.001$; 95% CI = 10.11 to 34.39; $t = 3.64$; SE = 6.11; $d = 1.70$) and the sedentary women ($p < 0.001$; 95% CI = 18.84 to 41.91; $t = 5.23$; SE = 5.80; $d = 1.69$). For the sedentary groups, a significant difference in CBD was found between the sedentary women and sedentary men, with a p -value of 0.001 (95% CI = −32.60 to −9.17; $t = -3.54$; SE = 5.89; $d = 1.04$). A graphical representation of the means of the body image indices among the groups is presented in Figure 3.

The one-way ANOVA indicated that there were no statistically significant differences in the BDI scores among the different PA groups ($F_{(5, 90)} = 1.55$; $p = 0.1816$; $\eta^2 = 0.079$). Moreover, no group had a BDI score > 30%, which is the threshold value indicative of individuals at risk of body image disorders [49].

The means and standard deviations of the EDS-21 dimensions and the EDS score are presented in Table 4.

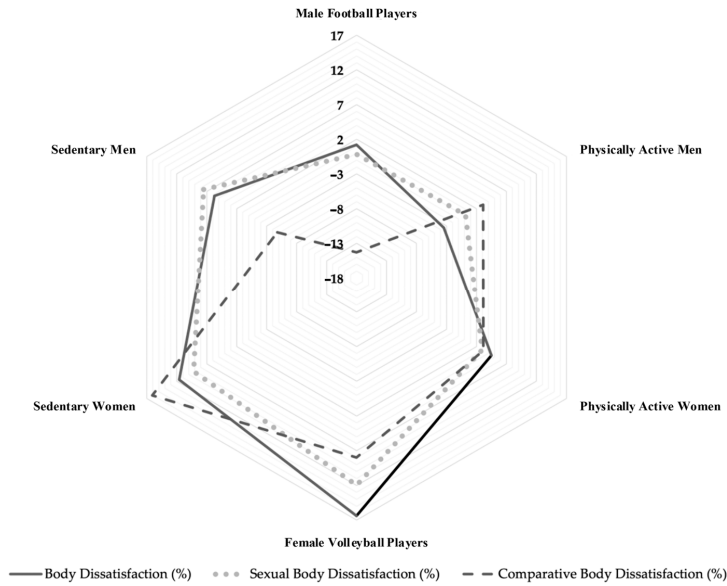


Figure 3. Radar chart of Body Image Dimensional Assessment indices, body dissatisfaction, sexual body dissatisfaction, and comparative body dissatisfaction, of team sport athletes, physically active participants, and participants with a predominantly sedentary lifestyle. Solid, dotted and dashed lines represent body dissatisfaction, sexual body dissatisfaction and comparative body dissatisfaction, respectively.

Table 4. Means and standard deviations of exercise dependence values.

EDS-21 Dimension (AU)	FPG	VPG	MPAG	FPAG	MSG	FSG
Withdrawal Effects	8.9 ± 4.5	9.8 ± 4.5	7.7 ± 3.1	8.7 ± 3.5	8.6 ± 4.9	7.2 ± 4.2
Continuance	4.9 ± 3.7	12.7 ± 4.8	5.1 ± 2.1	4.2 ± 1.6	7.3 ± 3.7	4.8 ± 2.7
Tolerance	11.9 ± 3.7	12.7 ± 3.8	12.8 ± 2.7	11.8 ± 3.9	11.2 ± 4.5	7.8 ± 4.5
Lack of Control	7.4 ± 3.2	9.3 ± 4.2	8.3 ± 3.7	7.6 ± 2.8	6.7 ± 3.4	4.3 ± 2.0
Reduction in Other Activities	6.5 ± 2.2	8.4 ± 4.3	7.0 ± 3.4	5.2 ± 2.0	6.4 ± 1.9	4.7 ± 2.0
Time	11.2 ± 3.0	11.8 ± 3.7	11.7 ± 2.9	11.1 ± 3.4	9.3 ± 3.3	6.1 ± 3.4
Intention Effects	8.3 ± 2.8	9.2 ± 5.0	8.0 ± 3.1	8.0 ± 2.4	7.5 ± 4.0	5.3 ± 3.4
EDS score	59.2 ± 14.2	74.2 ± 20.4	60.7 ± 11.9	56.6 ± 14.2	57.31 ± 19.9	40.5 ± 18.8

EDS = Exercise Dependence Scale; FPG = football players’ group, VPG = volleyball players’ group; MPAG = physically active men’s group; FPAG = physically active women’s group; MSG = sedentary men’s group; FSG = sedentary women’s group.

The MANOVA results revealed a significant multivariate effect of PA level on exercise dependence (tolerance, withdrawal, intention effects, lack of control, time, reductions in other activities, continuance) (Wilks’ Lambda = 0.3112; $F_{(35, 355.8)} = 3.25$; $p < 0.0001$; $\eta^2 = 0.15$; 95% CI = 0.01 to 0.25). Follow-up ne-way ANOVA indicated significant effects of PA level in several aspects: tolerance ($F_{(5, 90)} = 3.66$; $p = 0.0046$; $\eta^2 = 0.16$), lack of control ($F_{(5, 90)} = 4.16$; $p = 0.0019$; $\eta^2 = 0.18$), time ($F_{(5, 90)} = 7.05$; $p < 0.0001$; $\eta^2 = 0.28$), reductions in other activities ($F_{(5, 90)} = 3.89$; $p = 0.003$; $\eta^2 = 0.17$), and continuance ($F_{(5, 90)} = 13.94$; $p < 0.0001$; $\eta^2 = 0.43$). After adjustments using Bonferroni correction, significant differences were found. The sedentary women scored significantly lower than the volleyball players in several categories: lack of control ($p < 0.001$; 95% CI = -7.38 to -2.61 ; $t = -4.17$; SE = 1.20; $d = 1.49$), time ($p < 0.001$; 95% CI = -8.07 to -3.28 ; $t = -4.71$; SE = 1.20; $d = 1.56$), reductions in other activities ($p < 0.001$; 95% CI = -5.52 to -1.80 ; $t = -3.92$; SE = 0.93; $d = 1.07$), tolerance ($p = 0.001$; 95% CI = -7.71 to -2.06 ; $t = -3.44$; SE = 1.42; $d = 1.15$), and continuance ($p < 0.001$; 95% CI = -10.18 to -5.47 ; $t = -6.61$; SE = 1.18; $d = 1.99$).

Additionally, the volleyball players' group showed significantly higher values than the football players' group in continuance ($p < 0.001$; 95% CI = 5.41 to 10.12; $t = 6.56$; SE = 1.18; $d = 1.79$) as well as compared to the sedentary men, physically active men, and physically active women in the same category, and in reduction in other activities than physically active women ($p = 0.001$; 95% CI = -5.14 to -1.31 ; $t = -3.35$; SE = 0.96; $d = 0.94$). Significant differences were also observed in the sedentary women from the other groups in terms of time. Specifically, the sedentary women differed significantly from the football players' group ($p < 0.001$; 95% CI = -7.27 to -2.72 ; $t = -4.36$; SE = 1.14; $d = 1.53$) and from the physically active women ($p < 0.001$; 95% CI = 2.53 to 7.24; $t = 4.13$; SE = 1.18; $d = 1.41$). Additionally, the sedentary women showed significantly lower values than the physically active men in time ($p < 0.001$; 95% CI = 3.31 to 7.86; $t = 4.88$; SE = 1.14; $d = 1.73$), tolerance ($p < 0.001$; 95% CI = 2.31 to 7.68; $t = 3.70$; SE = 1.34; $d = 1.32$), and lack of control ($p = 0.001$; 95% CI = 1.67 to 6.20; $t = 3.45$; SE = 1.14; $d = 1.30$). A graphical representation of the means of the EDS-21 dimensions and the EDS scores among the groups is presented in Figure 4. Moreover, no group reached < 14 points on three of the seven dimensions; therefore, they did not present a significant risk of exercise dependence [51].

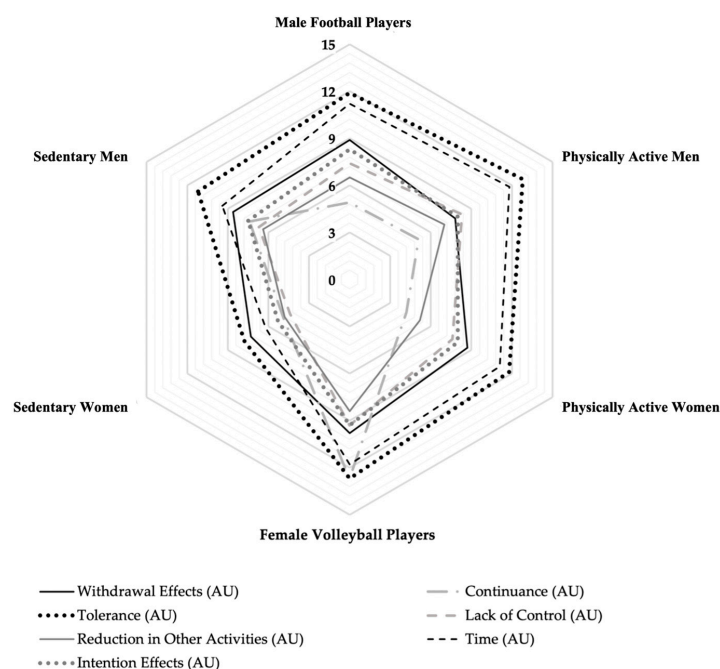


Figure 4. Radar chart of seven dimensions of 21-item Exercise Dependence Scale: tolerance, withdrawal effects, intention effects, lack of control, time, reductions in other activities, and continuance for athletes engaged in team sports, physically active participants, and participants with a predominantly sedentary lifestyle. Solid black, dotted black, solid grey, dotted grey, dotted and dashed, dashed grey, and dashed black lines represent withdrawal effects, tolerance, reductions in other activities, intention effects, continuance, lack of control, and time, respectively.

The one-way ANOVA showed significant differences in the EDS scores among the different PA groups ($F_{(5, 90)} = 6.39$, $p < 0.0001$, $\eta^2 = 0.26$). The subsequent post hoc analysis indicated that the sedentary women had significantly lower EDS scores than the volleyball players' group ($p < 0.001$; 95% CI = -45.66 to -21.58 ; $t = -5.55$; SE = 6.06; $d = 1.71$), the football players' group ($p = 0.002$; 95% CI = -30.15 to -7.25 ; $t = -3.25$; SE = 5.76; $d = 1.12$), and the physically active men ($p = 0.001$; 95% CI = 8.67 to 31.56; $t = 3.49$; SE = 5.76; $d = 1.21$).

4. Discussion

This study examined the effects of lifestyle, including team sport participation, PA levels, and sedentary behavior on body image and exercise dependence. Regarding body image, the findings suggested that sex and the level of PA significantly affected participants' BD across the measured indices. A total of 42.74% of the variance in the BD indices could be attributed to in sex and PA level differences among the groups, highlighting the substantial effect of PA and sex differences on body image perceptions. In particular, differences in BD were observed between the football players' group and volleyball players' group, as well as between the physically active men and both the volleyball players and sedentary women, indicating that the type of sport, the level of PA, and sex play a role in influencing body image perceptions. In the CBD, differences were found between football players and both volleyball players and sedentary women, and between the sedentary groups, with women showing different from the sedentary men, highlighting meaningful differences in body image perceptions across groups with different PA levels. PA emerged as also having an impact on exercise dependence, with 68.88% of the variance attributable to the different levels of PA among the groups, indicating a strong relationship between PA levels and the tendency toward exercise dependence. The findings of this study showed the influence of the type of sport on BD, where football players and volleyball players had differences in BD, highlighting that beyond sex, the different physique demands of a sport could influence the perception of one's body.

PA participation is associated with a multitude of positive outcomes, both physical (e.g., enhanced physical fitness through reduced body fat and increased muscle mass) and psychological (e.g., improved mood and self-esteem, alongside decreased anxiety and depression), which can contribute to a more positive body image [7,11,21,22,52]. The literature has mainly focused on the benefits of exercise interventions (strength vs. aerobic) or levels of PA commitment on body image [7,11,33,53,54]. However, in the present study, we also took into consideration the sedentary lifestyle (long sitting time), considering the evidence on the importance of the deleterious health consequences of prolonged sitting, which may be independent of the protective effect of regular PA [44]. In line with the literature [7,8,21], the present study confirms the central (positive) role of PA, particularly when it meets or exceeds public health recommendations, in individual body perceptions. In fact, the physically active men reported a more favorable body image than sedentary women, with the large ES indicating a 15% difference between groups. Although the sedentary women reached the minimum recommended amount to be classified as minimally active [36], the long time spent sitting could have influenced their BD. Investigating the differences between perceived and actual weight changes among university students during the COVID-19 pandemic, Keel et al. [55] reported that participants had a tendency to feel they had gained weight and were eating more, spending more time watching TV/movies and on social media, and gaming, although no significant changes in weight were reported. Despite the benefits of PA on both physical and psychological health, the deleterious impacts of prolonged sitting may attenuate these advantages, suggesting that focusing on reducing sitting time, alongside increasing PA levels, may be used as a health promotion strategy to reduce BD. Moreover, individuals with long sitting time could spend more time watching TV or on social media, which broadcast thinness ideals that are difficult to achieve without constant commitment to training and nutrition, fostering BD [56]. The significant differences in BD between the physically active men and the sedentary women, as opposed to the nonsignificant differences observed between the physically active men and sedentary men, underscore the combined influence of sex and the role of PA on individual body perceptions. This finding aligns with that of Fischetti et al. [57], who investigated the impact of sex and exercise differences on BD, reporting lower BD in physically active men than in inactive women, though the differences were not significant when comparing active men to their inactive counterparts. Furthermore, the differences observed between football and volleyball players provide additional evidence supporting the strong influence of sex on body image, highlighting that sex is a factor influencing individual BD. It is widely acknowl-

edged that women tend to exhibit greater BD than their male counterparts [10,19,58–60]. According to Fredrickson and Roberts' objectification theory [61], women are more likely to internalize an observer's perspective as a primary view of their physical appeal, which may contribute to their increased BD. Therefore, these sex-based differences in perception might overshadow the positive changes brought about by PA and short sitting time. In fact, while PA can improve body image, the impact of sex-related social factors can be more influential, particularly in inactive populations [19]. Sex differences and engagement in physical training appear to play a role in shaping CBD. The sedentary women reported more positive values than the sedentary men, with the large ES indicating that 60.3% of the two groups overlapped, suggesting that women with long sitting time may perceive their body image as being less aligned with social norms than their male counterparts. The potential impact of sex on body image in athletes represent a topic where it is difficult to draw conclusions, given the contradictory findings in the literature. Francisco et al. [62] reported that gymnasts and ballet dancers, regardless of their sex, felt the pressure to be thin, while others [63–65] found that female athletes felt more pressured to fit a lean ideal and experienced more BD and a less positive body image. Investigating the relationship between intensive sporting practice and body dysmorphism, Iacolino et al. [66] reported that being female and having a higher level of difficulty in identifying feelings were predictive of the general level of body uneasiness, avoidance, and concerns about their body. In the present study, although football and volleyball players demonstrated body images differing from those of their less active peers, higher BD was found in volleyball players. Moreover, the large dimension of the ES indicated that 83.9% of the volleyball players' group had a mean above the mean of the football players' group, which, as suggested in the literature [15,67], could be attributed to differences in both sex and the type of sport. Indeed, sports can be classified as "aesthetic/lean" and "nonaesthetic/non-lean" [68], where BD seems to be higher in weight-sensitive (i.e., aesthetic) athletes, such as ballet dancers, who seem to be more dissatisfied than others due to the perception of being overweight with a greater desire to be thin, especially in female dancers. Although volleyball does not fall into this category, their training, focusing on upper limb strength [69], increases muscle mass in these areas, which may result in physiques differing from traditional female aesthetic ideals. Football training requires extensive aerobic and anaerobic work [70], developing physiques more aligned with society's ideals, which could positively influence football players body image. The benefits of football practices on body image have been documented in the literature [71,72] investigating the effects of a football training program on body composition and body image satisfaction among preadolescents, reporting improvements in body composition and decreases in BD, suggesting the positive benefits of this sport on physical and psychological health. Therefore, given the physical demands of volleyball, players might experience more BD if they do not identify with their ideal body type. According to Steinfeldt et al. [73], volleyball players experience a paradox where women appreciate the power and strength of their bodies and acknowledge the importance of being muscular, although being aware of the contrasting societal body type expectations that contribute to their desire to avoid being perceived as too muscular and not conforming to traditional aesthetics norms of femininity. Moreover, collegiate women volleyball players internalized a physique as more muscular and athletic than nonathletes as not fitting with society's ideals [74]. That study's findings are in line with the present findings, where the volleyball players had higher values than those reported in the physically active men, where there was a 94.9% chance that a person picked at random from the volleyball players' group had a higher score than a person picked from the physically active men. This difference further underscores the specific training completed by athletes in sports with highly specialized physical requirements in comparison with individuals taking advantage of the health benefits of exercise without a performance context. Although the involvement in sport "protected" athletes from body image concerns, this protection was less present in women. Therefore, given the interaction with sex [15,68,75], the effect of sport type on BD differed between men and women. The literature identifies a threshold value of higher

than 30% in the BDI as indicative of a risk of body image disorders [49]. In the present study, no significant group differences were observed, and the threshold was not reached or exceeded. These findings could be attributed to the specific characteristics of the sample such as the participants' body composition, as the participants predominantly presented a normal BMI, thus probably limiting the risk of body image disorders. Therefore, future research should consider incorporating a more diverse sample by including overweight and underweight populations to possibly provide more information into the relationship between PA commitment and body image disorders in a nonhomogeneous sample.

Although regular PA, exercise, and sports participation at various competitive levels are important for improving and maintaining mental and physical health, increasing the amount of physical training could lead to compulsive behaviors or addiction [23,76–78]. Our findings confirm that the prevalence of exercise addiction risk is generally higher among regular exercisers than in the general population [79,80]. In fact, the sedentary women had lower scores in the different dimensions of exercise dependence than the physically active men and volleyball players, highlighting the paradoxical phenomenon where long sitting time, despite the general health risks associated, could have a protective role on exercise behavior. However, these dissimilarities were not found in the sedentary men, highlighting sex differences in exercise dependence. The literature [25–27] suggests that men generally score higher in exercise dependence than women, probably due to social dynamics, where men have greater motivation to exercise and increase the amount and intensity of training, independent of their sitting time. It might be possible that, for men, exercise is essential for obtaining a strong and muscular physique, whereas women may find that exercise may not yield their desired (thin) physique [26], which is not achieved unless through caloric restriction in the dietary regimen.

Volleyball players had higher values for lack of control, time, reductions in other activities, tolerance, continuance, and EDS score than the sedentary women. This highlights the potential negative impact of sports, especially in continuance, where the large ES indicated a 92% likelihood that a randomly selected volleyball player would score higher than a randomly selected sedentary woman. Competitive athletes tend to exhibit more symptoms of exercise dependence than noncompetitive athletes. In fact, Condello et al. [21] reported that senior athletes showed significantly higher values in all dimensions of the EDS-21 than sedentary counterparts, indicating how sport commitment represents a risk of maladaptive exercise behaviors similar to those found in younger athletes. Due to their competitive nature and rigorous training demands, sports can lead athletes to push their limits to improve performance, which can result in an obsessive and compulsive relationship with their sport [21,23,76,79,81]. Although the volleyball players demonstrated differences from the sedentary women in several dimensions of the EDS, in line with the literature [82], these dissimilarities were not present in the football players, where individual-sport athletes had a higher risk of exercise dependency than team-sport ones. A systematic review [79] showed that distinct factors could play roles in the development of exercise dependence in sport practices, such as obsessive passion and dedication, social physique anxiety, eating disorders, and weight and shape concerns [79]. Weight concerns and BD could be relevant factors explaining the higher scores observed in several dimensions of exercise dependence in the volleyball players' group. This might suggest an association between BD and exercise dependence, where individuals with negative perceptions of their body image may choose to excessively exercise as a method to enhance their physical appearance and achieve their aesthetic ideals [33,60]. A positive correlation was found [83] between thin-ideal internalization and compulsive exercise in college students, who increased their training to achieve their ideal body. Thin-ideal internalization also mediated the relationship between personality traits—such as neuroticism, extraversion, and conscientiousness—and exercise behaviors [83]. Consequently, BD is an important factor to consider in the exercise context, and understanding these dynamics is essential for developing more holistic approaches to managing exercise dependence, particularly in competitive sports settings [33].

The present study identified significant findings concerning body image and exercise dependence across various groups. However, the representativeness and the generalizability of these findings may be limited due to the characteristics and the type of sport included. Different sports require, among others, specific body compositions to achieve optimal performance [68]. Moreover, we considered the team sports most commonly practiced in Italy for men and women, although other types of sports should be targeted in future research. Sports like bodybuilding emphasize the need for high muscle hypertrophy and a low percentage of body fat, while dancers and gymnasts tend to require a thin and lean body [15,68]. Similarly, studies in sports like powerlifting and sumo, where athletes can gain performance-related benefits from increased body mass and fat [84,85], could enrich the theoretical assumptions made in the present study. Another limitation is that we considered different sports for each sex (football for men and volleyball for women). This approach was intentional for our study design, allowing us to have groups that were representative of the typical sports played in Italy. However, this choice could be a potential confounding factor, as the observed differences in body image and exercise dependence may have been influenced not only by the type of sport but also by sex. Therefore, future studies could investigate the effect of different sport practices including both sexes within each sport type to provide a clearer understanding of the impact of sport type on psychological outcomes. Lastly, although MANOVA was used in our analysis to investigate the effects of sitting time on BD and exercise dependence, it could also be interesting to explore the correlation between sitting time and these psychological outcomes, providing further insights into how sedentary behavior impacts body image and exercise dependence.

5. Conclusions

This study aimed to evaluate the effects of team sport participation, PA engagement level, and sitting time on body image and exercise behaviors according to sex. The results showed differences between the groups in BD, as well as higher levels of exercise dependence in physically active men and volleyball players with respect to women with longer sitting time. Specifically, this study found that volleyball players exhibited higher levels of BD and a greater risk of developing maladaptive exercise behaviors than football players and physically active men. These findings are in line with the hypothesis of this study that different lifestyles, such as practicing sport, engaging in PA, and long sitting time could differently influence the perception of one own's body, also highlighting the importance of differences sex and the type of sport.

While PA and engagement in sports positively contribute to body image perception, particularly in men, excessive exercise can reduce these health benefits, especially in women. Furthermore, this study highlights the impact of sedentary behaviors on these outcomes, with participants sitting for long time showing differences in body image and exercise dependence compared to the other groups. Therefore, prolonged sitting could have a negative influence on body image and a protective role on reducing exercise behaviors, despite its general association with negative health effects. Thus, a careful balance between exercise and mental health is essential, particularly within competitive sports contexts. Achieving such a balance can help with reducing the risks of excessive dependency on exercise and having a healthy approach toward PA and sports. This research provides more insights into personalizing approaches for promoting healthy exercise habits across different populations and sport disciplines. By understanding these findings, it will be possible to develop interventions that balance PA and mental health, particularly in competitive sports contexts.

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Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki. The research protocol was approved by the Institutional Review Board of the Department of Human Sciences, Society and Health of the University of Cassino and Lazio Meridionale (Approval No.: 9407; dated 8 March 2023).

Informed Consent Statement: Written informed consent was obtained from all participants.

Data Availability Statement: The data acquired and analyzed in the present study are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflicts of interest.

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Article

Eating Right, Sleeping Tight? A Cross-Sectional Study on the Student-Athlete Paradox for Diet and Sleep Behaviors

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Abstract

Background: Student-athletes face the dual challenge of balancing academic and athletic commitments, which may simultaneously promote healthy lifestyle habits while increasing psychosocial and physiological stressors, particularly among female student-athletes. Understanding how these competing demands affect key behavioral (e.g., dietary habits, sleep, and chronotype) and psychological (e.g., body image) factors is essential for supporting their overall well-being. Therefore, this cross-sectional study investigated body dissatisfaction, adherence to the Mediterranean diet, sleep quality, and chronotype in female student-athletes compared to sedentary peers. **Methods:** Twenty-eight female participants voluntarily participated in the study. Twelve volleyball student-athletes (age 21.6 ± 2.4 years) were assessed during their competitive in-season period, and sixteen non-athlete students with a high sitting time (age 24.0 ± 3.2 years) completed the Mediterranean Diet Adherence questionnaire (PREDIMED), Pittsburgh Sleep Quality Index (PSQI), Morningness–Eveningness Questionnaire (MEQ), and Body Image Dimensional Assessment (body dissatisfaction) to assess their overall well-being. **Results:** Student-athletes showed significantly ($p < 0.05$) higher adherence to the Mediterranean diet (PREDIMED: 8.5 ± 1.5 score), although experiencing poorer sleep quality (PSQI: 6.8 ± 3.0 score) compared to non-athlete students with higher sitting times (PREDIMED: 6.7 ± 1.6 score; PSQI: 4.6 ± 2.3 score). Conversely, comparative body dissatisfaction was significantly higher in non-athlete students with a high sitting time ($19.4 \pm 24.5\%$) than in student-athletes ($5.6 \pm 10.5\%$). No significant differences emerged for chronotype or overall body dissatisfaction. **Conclusions:** These findings highlight a paradoxical health pattern in female student-athletes who combine healthier eating habits with poorer sleep quality. The results emphasize the importance of comprehensive wellness strategies that integrate dietary habits, sleep hygiene, and psychophysiological factors to better support female student-athletes in managing dual-career demands.

Keywords: Mediterranean diet; physical activity; sedentary behaviors; sleep quality; collegiate athletes



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1. Introduction

Student-athletes represent a specific population facing unique physical, psychological, and social demands. To achieve holistic development, student-athletes have the right to combine their higher sport and education careers (e.g., dual career), both of which are relevant to empowering their future role in society, especially at the end of their competitive sport period [1]. Interest in this population has increased in recent years, driven in part by the growing attention from organizations such as the European Athlete as Student (EAS) Network [2] and the European Commission [3]. Moreover, scholars introduced the concept of dual-career balance, defined as “a combination of sport and studies that helps them to achieve their educational and athletic goals, live satisfying private lives, and maintain their health and well-being” [4].

Originally, sport participation, and specifically the presence of student-athletes, was predominantly male-oriented. However, in recent years, female participation in high-level sport (e.g., Olympic level) has progressively increased, approaching parity with male counterparts [5], with a significant number of student-athletes [6]. However, female representation remains unequal in sports research [7], which tend to focus on male performance rather than the general well-being of student-athletes. In this context, well-being should be understood not only in terms of physical health but also in psychological resources that sustain athletes across domains. Accordingly, in the last decade, mental health has emerged as a key resource for achieving both academic and athletic success [8].

The World Health Organization (WHO) defines mental health as a state of well-being that enables people to cope with life stresses, achieve their goals, work productively and contribute to their community [1]. This concept is closely linked to quality of life, reflecting an individual’s perception of their position in life in the context of their goals, expectations, standards, and concerns [9]. Regular participation in physical activity, structured exercise, and sports, typical for student-athletes, has been shown to reduce anxiety and depression, enhance confidence, and improve mood [10], particularly in females [11]. In contrast, prolonged sitting time and sedentary behaviors can negatively affect mental health and quality of life [12].

Optimal mental health and athletic performance cannot be sustained by focusing on a single behavior. Instead, a combination of interconnected lifestyle factors, including physical activity and exercise, sleep, dietary habits, and body image, collectively influences psychological well-being, physical recovery, cognitive functioning, and overall quality of life in student-athletes. Disruptions in one area often affect others, warranting multi-dimensional health promotion strategies [13]. Student-athletes generally adopt healthy habits such as adherence to a balanced diet like the Mediterranean diet, which is known to support physical recovery, mental health, and positive body image. However, sleep quality is often poor in this population [14] and age group [15], creating a paradox where healthy nutrition contrasts with inadequate rest, potentially limiting the benefits of both.

Previous study [16] has shown that sleep deprivation and chronic sleep loss negatively affect cognitive performance, learning, memory, reaction time, vigilance, mood, recovery, and physical performance, particularly in strength-based activities, while also being associated with metabolic and endocrine alterations. Optimal sleep is thus vital for athletes since sports performance depends on cognitive, physiological, and physical integration. Maximizing athletic performance is a primary objective for many student-athletes, particularly those aiming for athletic scholarships or professional careers. Sleep deprivation negatively affects anaerobic capacity, sport-specific skills, and neurocognitive functioning [17], highlighting the essential role of adequate sleep quality and duration in training, recovery, mood regulation, and overall sports performance [18].

Dual-career athletes, when compared to their student peers, might be more likely to present with sleep problems since they manage additional social roles and significant time demands, potentially negatively impacting sleep patterns and recovery processes [19]. Moreover, academic and training schedules may not align with their natural sleep preferences or chronotype (e.g., an individual's preferred timing for sleep and daily activities within a 24 h cycle), which might influence sleep quality, sleep duration, and social jet lag, particularly among populations with irregular schedules. Furthermore, it affects daytime functioning, including academic performance, daytime sleepiness, and work-related fatigue, and has been associated with various physical and mental health aspects, such as metabolism and dietary habits [20]. Optimum nutrient intake and good dietary habits have been recognized as key factors in improving athletic performance in terms of quality of training and speedy recovery from exercise in athletes. Variable results have been reported regarding nutrition knowledge of student-athletes, with good dietary knowledge and habits positively associated with better general mental health outcomes [21], as well as a more positive body perception and body image [22], improved mood, and reduced perceived stress. These effects might be especially relevant for athletes who are exposed to both physical–psychological demands and academic responsibilities. A balanced and nutrient-rich diet, such as the Mediterranean diet, may support enhanced recovery, reduced inflammation, and improved overall performance [23]. Moreover, evidence suggests that recreational physical activity mediates the association between dietary intake of live microbes and the systemic immune-inflammation index, indicating that the favorable link between diet quality and inflammatory burden may be partly realized through physical activity, thereby supporting an integrated lifestyle framework for understanding student-athletes' health behavior patterns [24,25]. Moreover, a close connection emerged between dietary habits, and body image [26], which is a multidimensional construct comprising a behavioral aspect related to body-related behaviors (e.g., checking behaviors), a perceptual aspect regarding body characteristic perceptions (e.g., estimating one's body size or weight), and a cognitive–affective aspect involving thoughts and feelings toward one's body. Body image, dietary adherence, sleep quality, and chronotype represent critical factors that may influence both the physical performance and psychological well-being of athletes, especially student-athletes, further highlighting the need for a multidimensional approach. Although these aspects play a key role in promoting health, there is still a lack of research simultaneously addressing these interconnected dimensions, especially in dual-career athletes. Thus, it remains unclear whether these dimensions are considered in promoting the health and performance of student-athletes, which is particularly concerning given recent evidence of persistent gender disparities in sport and exercise science research [27]. This disparity in research representation raises critical questions about the understanding of female student-athletes' experiences and needs, particularly in the field of mental health and well-being. This limits our understanding of how these interconnected lifestyle dimensions influence well-being and performance in dual-career female athletes, which is a group facing unique physical, psychological, and social demands.

To address this gap, the present study aimed to evaluate adherence to the Mediterranean diet, sleep quality, chronotype and body dissatisfaction among female student-athletes compared to sedentary peers. We hypothesized that student-athletes would demonstrate greater adherence to the Mediterranean diet but poorer sleep quality, reflecting the higher demands of training and competition. In contrast, we expected no substantial between-group differences in chronotype and body image, as these characteristics are likely inherent to the populations under study.

2. Materials and Methods

2.1. Participants

Twenty-eight female participants were recruited from the University of Cassino and Lazio Meridionale. In adherence to the Declaration of Helsinki, this cross-sectional study protocol was approved on 8 March 2023 by the Institutional Review Board of the Department of Human Sciences, Society and Health at the University of Cassino and Lazio Meridionale (approval Number 9407) and conducted at the Human Performance Lab (HPL). The total sample ($n = 28$) was divided based on their athletic status. The student-athletes group consisted of volleyball players from the university's official team ($n = 12$), assessed during their in-season competitive period. The number of participants reflects the usual number of volleyball players on a team. Including an entire team ensured that participants had similar training schedules, competitive experience, and environmental conditions, reducing potential confounding factors that could arise from mixing athletes of different sports or performance levels. Since physical activity and sedentary behaviors are not the opposite of each other, individuals may meet recommended levels of physical activity and still accumulate high sedentary time, which represents an independent risk factor for adverse health outcomes [28]. Moreover, sitting time (>5 h per day) has been used as the primary criterion to identify individuals with sedentary behaviors, independently of their physical activity levels, and the literature highlights its impact on health outcomes such as body image and exercise dependence, and has negative physiological effects [29]. For these reasons, the inclusion of participants in the peer group was independent of their actual levels of physical activity; non-athlete students ($n = 16$) with a high sitting time were included and assessed using the Italian short version (7 items) of the International Physical Activity Questionnaire (IPAQ).

2.2. Procedures

Body mass (kg) and height (m) measurements were recorded using a Seca 709 scale equipped with an integrated stadiometer, with precision up to 0.1 kg for weight and 0.1 cm for height (Vogel & Halke, Hamburg, Germany). The body mass index (BMI) was calculated using the formula of weight in kilograms (kg) divided by the square of height in meters (m^2). All participants were classified as young adults (aged between 18 and 35 years) and had a BMI within the non-clinical range (18.5 – 29.9 kg/m^2) [30,31]. The participant's characteristics are detailed in Table 1.

Table 1. Means and standard deviations (SDs) of the participants' anthropometric characteristics.

	Student-Athletes ($n = 12$)	Non-Athlete Students with High Sitting Time ($n = 16$)	Total ($n = 28$)
	Mean \pm SD (Min–Max)	Mean \pm SD (Min–Max)	Mean \pm SD
Age (years)	21.6 \pm 2.4 (19–26)	24 \pm 3.2 (20–32)	23 \pm 3.1
Body Mass (kg)	64.3 \pm 8.1 (52–76)	64 \pm 8.2 (52–78)	64.5 \pm 8.1
Body Height (cm)	168 \pm 7 (159–180)	164 \pm 5 (153–177)	166 \pm 6
BMI (kg/m^2)	22.5 \pm 2.3 (18.8–25.9)	23.8 \pm 2.8 (19.2–28.8)	23.3 \pm 2.6

Min: minimum; Max: maximum.

Data collection was carried out during a single supervised session using standardized procedures and dedicated questionnaires. The procedure's timeline, lasting around 45 min, is illustrated in Figure 1.

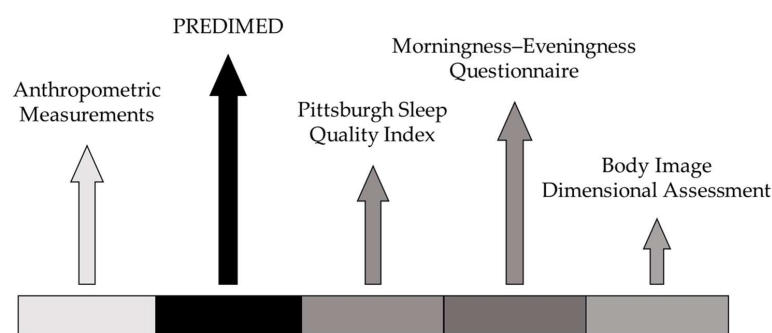


Figure 1. Timeline of experimental procedures. PREDIMED = PREvencción con Dieta MEDiterránea.

The Italian version of the PREvencción con Dieta MEDiterránea (PREDIMED) questionnaire was used to assess adherence to the Mediterranean diet [32]. PREDIMED is a 14-item questionnaire in which an adequate consumption of typical traditional Mediterranean foods and low consumption of foods that are not characteristic of the traditional Mediterranean diet results in one point. The PREDIMED score was calculated as the sum of all the points attributed to the items. Scores ranged from 0 (low adherence) to ≥ 10 (high adherence).

The Pittsburgh Sleep Quality Index (PSQI) evaluated subjective sleep quality and disturbances over the previous month. It includes 19 questions grouped into seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medications, and daytime dysfunction. Each component is scored on a scale from 0 to 3, with higher scores indicating greater dysfunction. A PSQI total score below 5 indicates good sleep quality, whereas scores ≥ 5 denote poor sleep quality [33].

The Morningness–Eveningness Questionnaire (MEQ) assessed individual preferences for the timing of daily activities. The questionnaire includes both Likert-type and time-based questions. Likert-type items offer four options, with lower scores indicating stronger evening preference. Time-based items are scored based on selected time intervals over a 7 h range, with all responses scored from 1 to 5. The total score is the sum of all item scores and is used to classify chronotype into five categories: definitely morning type (70–86), moderately morning type (59–69), neither type (42–58), moderately evening type (31–41), and definitely evening type (16–30) [34].

Body dissatisfaction was evaluated using the Italian-adapted Body Image Dimensional Assessment (BIDA) [35]. BIDA assesses subjective and emotional dimensions of body image using a neutral silhouette scale. The silhouette-based scale approach was chosen due to its effectiveness in minimizing biases from detailed and/or realistic images, focusing instead on basic body shape perceptions. Participants were asked to select silhouettes that represented their perceived and ideal body shape, the body shape that they believed was most prevalent among their peers, and the body shape they perceived as most attractive to the opposite sex. The scale offered a range of figures depicting different body shapes (extending from 1.8 to 5.2), allowing participants to choose intermediate values. Three indices were calculated:

- Body Dissatisfaction (BD): The difference between perceived and ideal body images.
- Sexual Body Dissatisfaction (SxBD): The difference between perceived body shape and the shape deemed most attractive by the opposite sex.
- Comparative Body Dissatisfaction (CBD): The difference between perceived body image and peers' typical shape.

Each index is expressed as a percentage that can range from -100% to $+100\%$. Positive values indicate that the participant's actual rating is higher than desired, compared to what is perceived as sexually attractive, or compared to the average among peers. Conversely, negative values suggest a lower self-assessment. A composite Body Dissatisfaction Index (BDI) was calculated (mean of absolute BD, SxBD, CBD values), with scores above 30% indicating risk for body image disorders.

2.3. Statistical Analysis

STATA software version 18 (StataCorp, College Station, TX, USA) was used for statistical analysis. The Shapiro–Wilk test was used to assess the normal distribution of the data. Means and standard deviations were calculated for all variables, while ranges were identified for anthropometric characteristics. One-way ANOVA examined differences between student-athletes and non-athlete students with high sitting times regarding PREDIMED, the PSQI score, the seven component scores of sleep (subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction), MEQ, and BIDA scores. Cohen's d (d) and the 95% confidence interval (95% CI) were used to evaluate the power of all the primary comparisons. In addition to group comparisons using ANOVA, multivariable regression analyses were performed with Heteroscedasticity Consistent (HC3) robust standard errors. Interaction terms were tested to evaluate potential moderation. Results are presented with coefficients (β), 95% CIs, p -values, and R^2 . The significance level was set at $p < 0.05$.

3. Results

IPAQ showed that the majority of student-athletes were classified in the HEPA-active category ($n = 10$; 83.3%), while two students (16.7%) were classified as minimally active. In contrast, the non-athlete students with high sitting times showed a more heterogeneous distribution, with seven (43.8%) classified as undertaking HEPA activity, seven (43.8%) as minimally active, and two (12.5%) as inactive. A significant difference between groups emerged for the PREDIMED score (Figure 2), with student-athletes reporting higher ($F_{(1,26)} = 8.03$, $d = 1.16$ [95%CI: 0.13 to 2.10], $p < 0.01$) adherence to the Mediterranean diet (8.5 ± 1.5 score) compared to non-athlete students with a high sitting time (6.7 ± 1.6 score). The multivariable regression model (Supplementary Table S2) explained 40.8% of the variance ($F_{(4,23)} = 2.94$, $p = 0.01$, $\beta = 2.24$, [95%CI: -3.95 to -0.52]).

Similarly, a significant difference between groups was observed for the PSQI total score (Figure 3), with student-athletes indicating poorer ($F_{(1,26)} = 4.69$, $d = 0.82$ [95%CI: 0.05 to 1.61], $p = 0.03$) sleep quality (6.8 ± 3.0 score) compared to non-athlete students with a high sitting time (4.6 ± 2.3 score). When applying the clinical cutoff value (PSQI ≥ 5), 75% of the student-athletes (9 out of 12) and 43.8% of the non-athlete students (7 out of 16) were classified as having poor sleep quality. No significant differences were found for any of the seven PSQI components between groups (Supplementary Table S1). Thus, the higher global PSQI score among student-athletes was not driven by a specific component of the PSQI but instead reflected the global effect across domains. The multivariable regression model (Supplementary Table S3) explained 35.5% of the variance ($F_{(4,23)} = 3.21$, $p = 0.007$, $\beta = -3.46$, [95%CI: -5.90 to -1.03]). Moreover, independently of the groups, lower sleep quality was associated with a higher BDI ($\beta = 0.11$, [95%CI: 0.00 to 0.21], $p = 0.04$). No significant relationships were found with PREDIMED and MEQ.

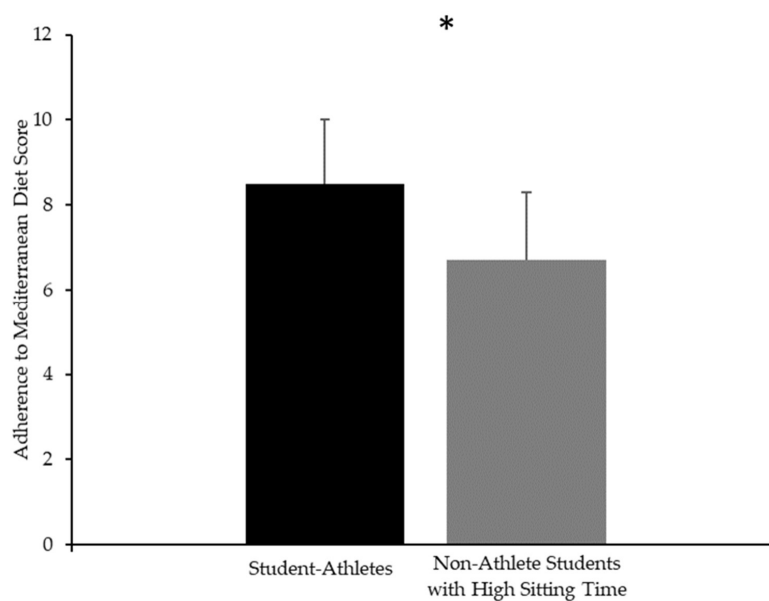


Figure 2. Mean and standard deviation scores of adherence to Mediterranean diet for student-athletes (black) and non-athlete students with high sitting time (gray). * Significant differences between groups ($p < 0.05$).

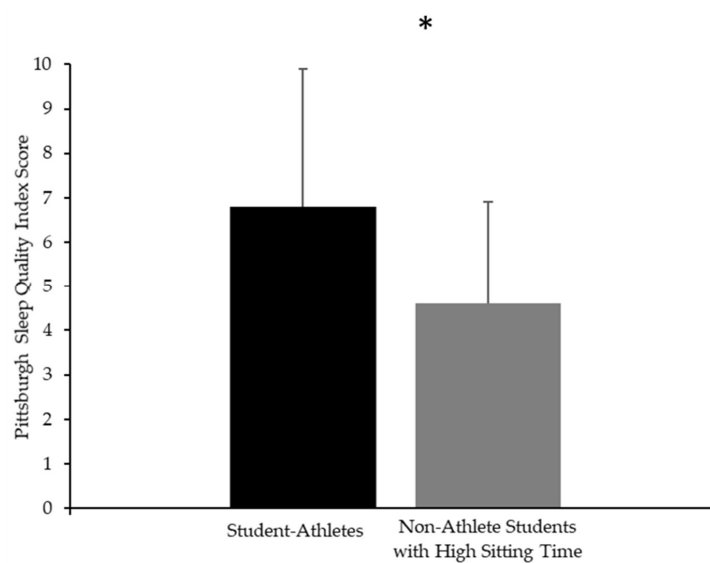


Figure 3. Mean and standard deviation scores of Pittsburgh Sleep Quality Index for student-athletes (black) and non-athlete students with high sitting time (gray). * Significant differences between groups ($p < 0.05$).

A significant difference between groups was also detected for CBD (Figure 4), with student-athletes reporting lower ($F_{(1,26)} = 3.31$, $d = -0.67$ [95%CI: -1.46 to -0.08], $p = 0.04$) CBD values ($5.6 \pm 10.5\%$) than non-athlete students with a high sitting time ($19.4 \pm 24.5\%$). The multivariable regression model (Supplementary Table S4) for CBD was not significant overall ($F_{(4,23)} = 1.69$, $p = 0.19$, $R^2 = 0.25$).

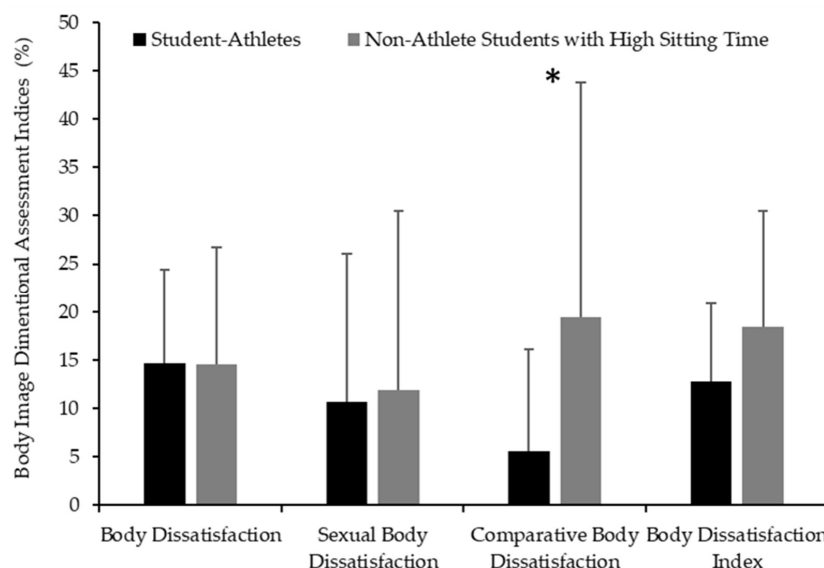


Figure 4. Mean and standard deviation scores of Body Image Dimensional Assessment for student-athletes (black) and non-athlete students with high sitting time (gray). * Significant differences between groups ($p < 0.05$).

No significant ($p < 0.05$) differences emerged between groups for the BD ($d = 0.01$ with 95%CI: -0.76 to 0.76), SxBD ($d = -0.06$ [95%CI: -0.81 to -0.03]), or BDI ($d = -0.51$ [95%CI: -1.28 to -0.25]). Regarding chronotype (Figure 5), no significant differences were found between groups (student-athletes: 48.6 ± 6.7 score; non-athlete students with high sitting time: 51.3 ± 9.8 score, $d = -0.3$ [95%CI: -1.06 to 0.44]). Most student-athletes were classified as neither type (91.7%), with only one participant (8.3%) reporting as being a moderately evening type. In contrast, non-athlete students with a high sitting time were more heterogeneous, with 56.3% classified as neither type (9 participants), 18.8% as a moderately morning type (3 participants), and 25% as a moderately evening type (4 participants). The multivariable regression model (Supplementary Table S5) explained 21.1% of the variance ($F_{(4,23)} = 1.45$, $p = 0.25$). Additionally, PREDIMED significantly predicted chronotypes ($\beta = 2.36$, [95%CI: 0.13 to 4.59], $p = 0.03$).

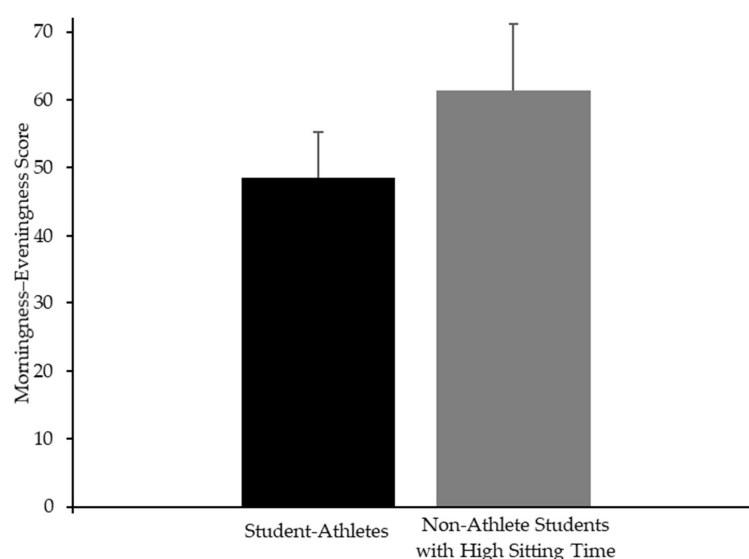


Figure 5. Mean and standard deviation scores of Morningness–Eveningness Questionnaire for student-athletes (black) and non-athlete students with high sitting time (gray).

4. Discussion

In the present study, we compared female volleyball student-athletes with non-athlete students with a high sitting time to determine whether adherence to the Mediterranean diet, sleep quality, chronotype, and body image differed between the two groups. Our findings highlight that although student-athletes demonstrated significantly higher adherence to the Mediterranean diet, they also reported poorer sleep quality compared to their sedentary peers. This paradox underscores the complexity of lifestyle behaviors among dual-career individuals, emphasizing how concurrent academic and athletic demands might compromise crucial psychophysiological aspects.

Our findings indicate that student-athletes showed higher adherence to the Mediterranean diet than non-athlete students with a high sitting time, which is in line with existing research indicating that athletes, especially within structured team settings, often have greater nutritional awareness and receive specific dietary guidance [21]. Participation in sports likely encourages beneficial health behaviors, including regular meals, appropriate nutrient timing, and selection of whole foods, driven by performance needs. However, the results could also be due to contextual factors, such as food availability and the competitive season. Environmental access (team routines, canteens/meal plans, nutritionist guidance) can facilitate the Mediterranean adherence diet, independent of individual knowledge about its health benefits. Moreover, the athletes were assessed in-season, when diet is often more tightly controlled for performance, although athletes could have a different approach to diet during their off-season. The poorer sleep quality observed among student-athletes raises concerns, since sleep plays a crucial role in physical recovery, cognitive function, and emotional regulation [16,26]. While student-athletes are typically considered healthy, these findings support increasing evidence of vulnerability to sleep disruptions due to factors like training volume schedules, irregular daily routines, pre-competition anxiety, and academic stress [36]. This unexpected pattern suggests that, although athletic participation may confer advantages in other health domains, it can also expose student-athletes to sleep-specific risk factors due not only to the dual-career demands, but also from requirements of specific sports, such as early-morning training, competition-related

anxiety, or greater recovery needs, which could further increase the risk of reporting sleep disturbances [37,38]. Moreover, early morning practices and evening competitions may misalign with natural circadian rhythms, particularly in those with an evening chronotype, potentially reducing sleep duration and efficiency [39]. Although previous studies indicate that Mediterranean diet adherence may improve sleep quality [40], our findings suggest that such beneficial effects may be reduced by behavioral and environmental stressors associated with dual-career lifestyles. It is possible that dietary benefits alone cannot fully offset chronic disruptions caused by conflicts between academic/athletic responsibilities and biological sleep preferences. Furthermore, no significant differences were observed between groups regarding chronotype scores, suggesting that external factors, like rigid academic and training schedules, may have a greater impact on sleep than intrinsic biological rhythms, as confirmed by the regression analysis showing that one additional point on the PREDIMED scale is associated with a 2.36 score increase in chronotype, indicating a possible link between healthier nutrition habits and being a morning-type person.

Regarding body image, no significant differences were found between groups for the overall BDI score. However, CBD was significantly higher among non-athlete students with a high sitting time, suggesting they perceive discrepancies between their bodies and peer standards. This difference may reflect the fact that while non-athlete students with a high sitting time might compare themselves to idealized societal or athletic images, student-athletes, being part of an environment focused on physical performance and functionality, could be less influenced by such ideals [41]. The significant difference found in CBD only highlights the importance of considering specific dimensions of body image, rather than referring to a global index when investigating mental health determinants in young adults. The lack of differences in other indices, in particular, BD and the BDI score, could be explained by sex differences in body perception, since females tend to exhibit greater BD than their male counterparts [29,42]. Therefore, future studies should consider comparing sex-related differences in BIDA indices. These alternative interpretations underscore the multifactorial nature of lifestyle behaviors and call for caution when attributing observed differences solely to the dual-career condition, emphasizing the need for a multidimensional understanding of the phenomenon.

Findings from the present study emphasize the importance of integrated health promotion strategies for student-athletes, addressing not only dietary habits and chronotype but also psychological factors, like body dissatisfaction, and sleep hygiene that may involve promoting awareness of circadian rhythms, providing strategies to help balance academic and athletic commitments, and integrating sleep optimization into training objectives. Additionally, institutional policies that acknowledge the challenges of dual careers [43], such as flexible class schedules and sport programs designed to support healthy sleep habits, play a crucial role in creating an environment where student-athletes can effectively balance academic responsibilities and athletic commitments, ultimately promoting both performance and well-being.

5. Clinical Implications

The present findings support the development of integrated health strategies for female student-athletes, aiming not only to promote adherence to balanced dietary models such as the Mediterranean diet but also to safeguard sleep hygiene and circadian alignment, crucial for psychophysical recovery and performance. From a clinical and preventive standpoint, the coexistence of healthy eating and poor sleep quality may limit the full benefits of nutritional strategies in athletic populations. Early screening for sleep disturbances, personalized chronotype-based scheduling, and multidisciplinary interventions involving dietitians, coaches, and sleep specialists could help optimize recovery, reduce

stress-related symptoms, and prevent performance decrements or long-term health risks. These insights are especially relevant in the context of health promotion among young adult women with high physical and academic demands, underscoring the value of integrative, evidence-based approaches in sports nutrition and preventive medicine.

6. Conclusions

This study highlights a paradoxical lifestyle among female student-athletes, emphasizing the importance of integrative health strategies to address both nutrition and sleep, as well as body image concerns, within dual-career contexts. Although exploratory in nature, the present work provides effect-size estimates that may guide future large-scale and longitudinal studies. A stronger focus on multidisciplinary interventions, combining nutritional guidance, sleep hygiene, and psychosocial support, will be essential to promote both well-being and performance in female student-athletes. Our findings also suggest that specific dimensions of body image, rather than global indices, may better capture mental health determinants in young adults. These findings underscore the interconnected nature of behavioral health and highlight the need for comprehensive wellness strategies that align with the realities faced by dual-career individuals. Addressing sleep as a critical area of vulnerability, together with nutrition and psychosocial factors, could enhance overall health, academic success, and athletic performance.

7. Limitations and Future Directions

This study presents several limitations, including a relatively small sample size restricted to the female university population, potentially limiting generalizability. Additionally, this cross-sectional study highlights differences between adherence to the Mediterranean diet, sleep quality, chronotype, and body image indices between student-athletes and non-athlete students with a high sitting time, but it cannot determine cause-and-effect relationships. Moreover, the use of self-reported instruments may have introduced potential biases and subjectivity. Future research should explore longitudinal changes in lifestyle factors throughout the academic year, incorporate objective sleep measures (e.g., actigraphy), and examine additional psychological variables such as stress, anxiety, and effective time management strategies. Moreover, we acknowledge that differences in physical activity levels within the non-athlete students could have introduced some heterogeneity, which should be considered when interpreting the findings. Therefore, future studies should aim to separate the roles of sedentary time and physical activity and their effect on health-related outcomes, ideally using larger samples, objective activity monitoring, and stratifying by both sitting time and IPAQ categories. A further limitation concerns the scope of statistical analyses. While group differences are presented with accompanying effect sizes, the sample size did not permit robust multivariate modeling or formal tests of interaction and covariation among variables. Consequently, we could not adjust for potential confounders (e.g., age, BMI, or physical activity level subcategories) or formally explore moderation/mediation effects. These analyses are important for clarifying causal pathways and context-dependent associations and should be prioritized in future studies with larger, multicenter samples using appropriate powered regression-based approaches (e.g., ANCOVA, linear mixed models, and structural equation modeling) to examine interactions, control for covariates, and test for mediation hypotheses.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/nu17182946/s1>, Table S1: Pittsburgh Sleep Quality Index (PSQI) component scores by group; Table S2: Multivariable regression model for Mediterranean Diet Adherence (PREDIMED) with HC3 robust SEs (N = 28); Table S3: Multivariable regression model for Sleep Quality (PSQI) with HC3 robust SEs (N = 28); Table S4: Multivariable regression model for Comparative Body Dissatisfaction (CBD) with HC3 robust SEs (N = 28); Table S5: Multivariable regression model for Chronotype with HC3 robust SEs (N = 28).

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of University of Cassino and Lazio Meridionale (protocol number: 9407, date of approval: 8 March 2023).

Informed Consent Statement: Written informed consent was obtained from the participants.

Data Availability Statement: Data are available in a publicly accessible repository: the original data presented in this study are openly available at <https://github.com/ccortis/DataBNR.git>.

Conflicts of Interest: The authors declare no conflicts of interest.

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Article

Sleep Quality and Adherence to the Mediterranean Diet in Male Young Adults: Insights from Amateur Soccer Players, Physically Active and Sedentary Individuals

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Abstract

Amateur soccer players, unlike professional athletes, represent the majority of participants and often combine training with study or work, facing daily challenges that can impact sleep, diet, and circadian-related behaviors. Since these factors are important for health, recovery, and well-being, this study aimed to examine sleep quality, adherence to the Mediterranean diet, and chronotype in amateur soccer players compared with physically active and sedentary peers. A total of 55 male young adults (23.3 ± 3.1 years) were allocated to three groups: amateur soccer players ($n = 20$), physically active individuals ($n = 18$) and sedentary individuals ($n = 17$). All participants completed the Pittsburgh Sleep Quality Index (PSQI), the PREvenición con DIeta MEDiterránea (PREDIMED), and the Morningness–Eveningness Questionnaire (MEQ). One-way ANOVA was used for group comparisons, while exploratory correlation was applied to explore the association between sleep, diet, and chronotype. Better sleep quality ($p < 0.001$) was found in soccer players (3.8 ± 1.3) and physically active (4.2 ± 1.9) than sedentary (6.2 ± 2.1) individuals. No significant differences were found in PREDIMED (soccer players = 6.8 ± 2.2 , physically active individuals = 7.5 ± 1.9 , sedentary individuals = 7.3 ± 2.4) and MEQ (soccer players = 51.6 ± 5.9 , physically active individuals = 50.9 ± 7.7 , sedentary individuals = 51.8 ± 11.4). A negative relationship was observed between MEQ and PSQI in sedentary individuals ($r = -0.514$, $p = 0.035$). These findings suggest that amateur soccer practices may support sleep quality through more structured daily routines, whereas adherence to the Mediterranean diet and chronotype appears independent of sport practices.

Keywords: chronotype; dietary patterns; sedentary behavior; physical activity level; young adults

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1. Introduction

Sleep plays a key role in health and well-being [1]. Poor sleep quality has been linked to mental health issues and reduced overall well-being [2,3], and is particularly relevant in young adults, who often experience irregular schedules due to academic, occupational, and social demands. Given its impact on both physical and psychological functioning, sleep quality represents a central outcome in lifestyle and health research. Among lifestyle-related factors, diet has been shown to be closely associated with sleep quality [4]. In particular, the Mediterranean diet, characterized by high intake of plant-based foods, antioxidants, and unsaturated fats, has been consistently associated with adequate sleep duration and several indicators of good sleep quality [5]. This dietary pattern has been proposed as a potential modulator of sleep-related outcomes, highlighting the importance of considering nutritional habits when examining sleep quality in young populations.

In addition to behavioral factors, biological circadian preferences further influence sleep. Misalignment between biological rhythms and socially imposed schedules may contribute to poor well-being [6] and impaired sleep quality [7]. Specifically, circadian rhythm disturbances and the resulting chronotype have been associated with poorer sleep quality and increased vulnerability to mental health symptoms, with evening-oriented individuals often reporting worse overall sleep compared with morning types, particularly when daily schedules do not align with their biological preferences [8,9]. Together, these findings suggest that chronotype may represent a relevant factor modulating sleep quality in daily life.

In the sports context, recovery is a key determinant of health and performance, particularly in disciplines characterized by high training loads as soccer [10,11]. Sleep is a key component of recovery, health, and performance, where high training loads, travel demands, and performance-related pressure are commonly associated with poor sleep quality [12–16]. Moreover, dietary habits and chronotype have also been shown to influence sleep outcomes in professional athletes, with healthier eating patterns and morning-oriented preferences generally associated with better sleep quality [13,15,17–19].

Most existing research has focused on elite or professional soccer players [20–22], who typically train in highly structured settings, receive nutritional and medical support, and rarely need to balance sport participation with occupational demands. In contrast, amateur soccer players represent the majority of sports practitioners in Italy [23], and often combine training and competition with work or university commitments. Within this context, achieving a satisfactory work–life balance is particularly challenging [24,25], as amateur athletes have limited time to dedicate to training and recovery while managing academic or occupational responsibilities [26]. As a result, training sessions are frequently scheduled in the evening, close to bedtime, which may represent a relevant factor influencing sleep-wake regulation and sleep quality [26,27]. This combination of occupational, academic, and sport-related demands makes amateur soccer players an important but understudied population in sleep and behavioral health research. Recent work has highlighted the importance of integrating sleep quality, dietary habits, and chronotype within a multidimensional approach when examining health-related outcomes [28]. This framework could also be extended in a sports context, as athletes' sleep quality may be influenced by their training schedules, nutritional routines, and individual chronotypes.

Unlike professional athletes, amateur soccer players are generally not exposed to the same levels of competitive pressure or nutritional support. Amateur sport participation typically occurs within a social environment characterized by lower performance demands and a stronger recreational component, which may reduce stress and the risk of dropout [29,30]. Within this perspective, daily routines related to training schedules, work

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or university commitments, and leisure activities may act as external time cues. According to the Social Zeitgeber Theory [31], environmental and social factors such as physical activity timing, social interactions, and daily schedules can influence circadian preferences and sleep-wake regulation. In amateur soccer players, the structured nature of training combined with regular occupational or academic routines may therefore expose individuals to different Social Zeitgebers compared with sedentary individuals, potentially influencing sleep quality.

Given these considerations, it remains unclear how sleep quality, adherence to the Mediterranean diet, and chronotype are characterized in amateur soccer contexts, and how these factors interact in comparison with physically active and sedentary individuals. Therefore, the primary aim of this study was to evaluate sleep quality, adherence to the Mediterranean diet, and chronotype in amateur soccer players compared with physically active and sedentary counterparts. A secondary aim was to investigate the associations between sleep quality, dietary adherence, and chronotype. Exploring these relationships may improve understanding of how sleep quality relates to lifestyle and circadian factors in amateur sport contexts. We hypothesized that amateur soccer players and physically active individuals would report better sleep quality than sedentary individuals, and that chronotype would be differently associated with sleep quality across groups. These expectations were based on the benefits of regular engagement in physical activity on good sleep quality. Moreover, daily schedules related to training, work, or academic commitments may promote more consistent sleep-wake behaviors, reducing the negative impact of circadian preference on sleep quality.

2. Materials and Methods

2.1. Participants

The research protocol, designed as a cross-sectional study, was conducted following the guidelines of the Declaration of Helsinki and received approval from the Institutional Review Board of the Department of Human Sciences, Society and Health of the University of Cassino and Lazio Meridionale (8 March 2023, approval number 9407). The study took place in the Human Performance Lab. Written informed consent was provided by participants and they were informed of their right to withdraw from the study at any time and for any reason. Participant recruitment and data collection were conducted between March and May 2023, with participants volunteering and receiving no financial or material incentives. All questionnaires were completed on a training day, prior to the start of the training session, to avoid the acute effects of exercise on sleep responses.

Twenty male soccer players were recruited from a regional-level amateur soccer team officially affiliated with the Italian Football Federation. All players regularly participated in structured team training sessions three times per week, each lasting approximately 90 minutes, in addition to one official match per week. Training sessions were typically scheduled in the evening, starting at 19:00. The sample size reflects the typical number of players in a soccer team. Recruiting an entire team ensured homogeneity in training schedules, competitive experience, and environmental conditions, thereby reducing potential confounding factors related to differences in sport discipline or performance level. Participants were required to have a minimum of four years of continuous soccer practice at the amateur level and to be actively engaged in both training and competition at the time of the study. Players were excluded if they reported any injury or medical condition that prevented full participation in training sessions or official matches. These criteria were adopted to ensure a stable training background and increase sample homogeneity. However, given the sample size, the present study should be considered exploratory. The recruitment and data collection of soccer players took place during the

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competitive season. Training sessions were conducted on weekdays, whereas official matches were typically played on weekends, and travel-related demands were not a factor during the weekdays.

To allow peer comparisons, eighteen physically active and seventeen sedentary male individuals were recruited from the university population. Physical activity levels and sedentary behavior were assessed using the Italian short version (7 items) of the International Physical Activity Questionnaire (IPAQ) [32]. Physically active individuals were classified as health-enhancing physical activity (HEPA) active according to established IPAQ criteria [32]. All participants in this group reported engaging in structured fitness-based physical activity three times per week, with each session lasting approximately 90 minutes. Training sessions were typically performed in the university gym facilities and scheduled in the late afternoon, after university lectures, at approximately 18:00. Sedentary individuals were identified primarily based on daily sitting time, assessed using the sitting item of the IPAQ, reporting the time spent sitting on a weekday during the previous seven days, including time spent at work, at home, during coursework, and leisure activities [32]. Given that prolonged sedentary behavior (> 5 hours per day) is recognized as an independent risk factor for adverse health outcomes, including cardiometabolic disorders and psychological distress [33–37], sitting time was used as the main criterion to define sedentary behavior, independently of overall physical activity levels. Accordingly, the sedentary group included participants who reported sitting for five or more hours per day. This classification allowed the distinction between individuals engaged in regular, structured physical activity and those characterized by high sedentary time, enabling the investigation of sleep quality, dietary adherence, and chronotype across different habitual activity profiles. The sitting time for sedentary and physically active individuals was 7.0 ± 2.1 and 2.6 ± 0.8 hours per day, respectively.

2.2. Procedures

Body weight (kg) and height (m) were measured using a Seca 709 scale with an integrated stadiometer (Vogel & Halke, Hamburg, Germany), with precision of 0.1 kg and 0.1 cm, respectively. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). During the session, participants were asked to complete a total of three questionnaires (fully described in subsequent sections): the Pittsburgh Sleep Quality Index (PSQI), the questionnaire for the assessment of PREvención con DIeta MEDiterránea (PREDIMED), and the Morningness–Eveningness Questionnaire (MEQ). All questionnaires were administered in a quiet environment to reduce distraction and improve response accuracy. The total time to complete the questionnaires was approximately 20 minutes.

2.2.1. Pittsburgh Sleep Quality Index

The Italian version PSQI was used to evaluate subjective sleep quality and disturbances over the previous month. It includes 19 questions grouped into seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medications, and daytime dysfunction. Each component is scored on a scale from 0 to 3, with higher scores indicating greater dysfunction. The sum of the component scores provides a total score ranging from 0 to 21, with 0 indicating no sleep issues and 21 indicating severe sleep difficulties and low sleep quality. A PSQI score below 5 indicates good sleep quality, whereas scores ≥ 5 denote poor sleep quality [38,39].

2.2.2. Questionnaire for the assessment of PREvención con DIeta MEDiterránea

The Italian version of the questionnaire for the assessment of PREDIMED was used to assess adherence to the Mediterranean diet. PREDIMED consists of 14 items evaluating the frequency of consumption and eating habits, related to extra-virgin olive oil, fruit, vegetables, nuts, legumes, red meat, poultry, fish, animal fat, sweetened beverages, sweets, and dishes seasoned with sofrito. When the answer to the item followed the pattern of the Mediterranean Diet, it received a score of 1; otherwise, it received a score of 0. The total PREDIMED score is obtained by summing the points across all items. Based on established cutoffs, adherence was categorized as follows: a score ≤ 5 indicated the lowest adherence, scores between 6 and 9 indicated average adherence, and a score ≥ 10 indicated the highest adherence [40,41]. The PREDIMED questionnaire has been applied in adult populations, including young adults, in Italian samples [16,42,43], although a validation specifically targeting young adult male or athletic populations is currently lacking. For this reason, the questionnaire was used to provide an overall estimate of Mediterranean diet adherence rather than detailed nutritional intake.

2.2.3. Morningness–Eveningness Questionnaire

The Italian version of the MEQ was used to assess individual preferences for the timing of daily activities (i.e., chronotype). The questionnaire includes both Likert-type and time-based items. Likert-type items offer four options, with lower scores indicating stronger evening preference. Time-based items are scored based on selected time intervals over a 7-hour range, with all responses scored from 1 to 5. The total score is the sum of all item scores, and it is used to classify chronotype into five categories: definitely morning type (70–86), moderately morning type (59–69), neither type (42–58), moderately evening type (31–41), and definitely evening type (16–30) [44].

2.3. Statistical Analysis

The statistical analysis was performed using the IBM SPSS Statistics, Version 29.0 (IBM Corp, Armonk, NY, USA). Continuous variables were expressed as mean \pm standard deviation, whereas categorical variables were reported as frequencies and percentages (%). The seven PSQI components were expressed as median, 25th and 75th percentiles. The continuous variables were PSQI score, seven PSQI components, PREDIMED score, and MEQ score. The categorical variables were good sleep quality and poor sleep quality for PSQI, while low adherence, average adherence, and high adherence for PREDIMED. For MEQ, the categorical variables were definitely morning, moderately morning, neither, moderately evening, and definitely evening. Shapiro–Wilk test was used to assess the normal distribution of the data.

One-way Analysis of Variance (ANOVA) was used to compare sleep quality (PSQI score), adherence to the Mediterranean diet (PREDIMED score), and chronotype (MEQ score) among the three groups (soccer players, physically active individuals, and sedentary individuals). Homogeneity of variances was assessed using Levene’s test. When this assumption was violated, Welch’s ANOVA was applied. When significant main effects were found, Bonferroni adjusted corrections were applied. Since the seven PSQI components were not normally distributed, non-parametric Kruskal–Wallis tests were used to compare subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medications, and daytime dysfunction among groups. When significant main effects were found, pairwise post-hoc comparisons were performed using Dunn’s test with Bonferroni adjustment. Effect sizes were calculated and interpreted using Cohen’s *d* and eta squared (η^2) for parametric analyses [45], while Rosenthal’s *r* for non-parametric tests [46]. Differences in the distribution of sleep quality categories (good vs. poor sleep quality), Mediterranean diet adherence categories (low, average, high), and chronotype categories (definitely morning,

moderately morning, neither, moderately evening, definitely evening) were assessed using Pearson's chi-square (χ^2) test.

Pearson's correlation coefficients (r) were calculated [45] to examine the associations between sleep quality (PSQI score), adherence to the Mediterranean diet (PREDIMED score), and chronotype (MEQ score). Correlation analyses were conducted separately for soccer players, physically active individuals, and sedentary individuals. All statistical tests were two-tailed, and a $p < 0.05$ was considered statistically significant. For post-hoc pairwise comparisons, significance was adjusted using Bonferroni correction. The 95% Confidence Intervals (CI) and Standard Error (SE) were calculated for group mean differences in post-hoc comparisons where appropriate. Moreover, 95% CI were also reported in correlation analysis.

3. Results

The characteristics of the participants are reported in Table 1.

Table 1. Means and standard deviations of participant characteristics.

	Soccer players n = 20	Physically active individuals n = 18	Sedentary individuals n = 17
Age (years)	23.4 ± 4.2	22.8 ± 2.8	23.9 ± 1.7
Body Mass (kg)	75.9 ± 13.0	74.6 ± 9.2	79.6 ± 14.4
Body Height (cm)	178.9 ± 6.9	175.4 ± 4.9	178.0 ± 9.8
BMI (kg/m ²)	23.6 ± 2.8	24.2 ± 2.3	25.0 ± 3.4

n = number; BMI = body mass index.

Shapiro–Wilk tests indicated that the total PSQI score was normally distributed in soccer players ($p = 0.085$), physically active individuals ($p = 0.052$), and sedentary individuals ($p = 0.477$). While the seven PSQI components were not normally distributed (all $p > 0.05$). PREDIMED score and MEQ score were normally distributed in soccer players (PREDIMED score: $p = 0.085$; MEQ score: $p = 0.795$), physically active individuals (PREDIMED score: $p = 0.052$; MEQ score: $p = 0.252$), and sedentary individuals (PREDIMED score: $p = 0.477$; MEQ score: $p = 0.291$). Levene's test indicated homogeneity of variances for the PSQI score ($p = 0.328$) and PREDIMED score ($p = 0.644$), whereas the assumption was violated for MEQ ($p = 0.018$). Therefore, Welch's ANOVA was used to compare MEQ scores between groups.

One-way ANOVA revealed a significant main effect ($F_{(2,52)} = 9.80$, $p < 0.001$, $\eta^2 = 0.27$) of physical activity level on PSQI score (soccer players = 3.8 ± 1.3 , physically active individuals = 4.2 ± 1.9 , sedentary individuals = 6.2 ± 2.1). Post-hoc Bonferroni comparisons indicated that sedentary males reported a higher PSQI score than soccer players ($p < 0.001$, 95% CI = 0.99 to 3.88, SE = 0.58, $d = 1.69$) and physically active males ($p = 0.003$, 95% CI = 0.59 to 3.55, SE = 0.60, $d = 1.98$). For the sleep quality components, Kruskal–Wallis tests showed a significant main effect for sleep duration ($\chi^2_{(2)} = 8.53$, $p = 0.014$) and subjective sleep quality ($\chi^2_{(2)} = 8.44$, $p = 0.015$) between groups. Pairwise comparisons indicated that sedentary individuals reported shorter sleep duration ($p = 0.016$, $r = 0.46$) and poorer subjective sleep quality ($p = 0.012$, $r = 0.48$) compared to soccer players. Pearson's χ^2 test showed a significant difference in PSQI categories ($\chi^2_{(2)} = 15.03$, $p < 0.001$). Good sleep quality was more frequent among soccer players (75%) and physically active individuals (72.2%) compared to sedentary individuals (17.6%). Table 2 summarizes the medians, 25th and 75th percentiles (first quartile – third quartile) of the seven PSQI components across groups.

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Table 2. Medians, 25th and 75th percentiles (first quartile – third quartile) of the seven Pittsburgh Sleep Quality Index components across groups.

Variable	Soccer players	Physically active individuals	Sedentary individuals
Subjective sleep quality	1.0 (0.0 – 1.0) *	1.0 (1.0 – 1.0)	1.0 (1.0 – 2.0)
Sleep latency	1.0 (0.0 – 1.0)	1.0 (0.0 – 1.25)	1.0 (0.0 – 2.0)
Sleep duration	0.0 (0.0 – 0.0) *	0.0 (0.0 – 1.0)	1.0 (0.0 – 2.0)
Habitual sleep efficiency	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.5)
Sleep disturbance	1.0 (1.0 – 1.0)	1.0 (1.0 – 1.0)	1.0 (1.0 – 1.0)
Use of sleeping medications	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)	0.0 (0.0 – 0.0)
Daytime dysfunction	0.5 (0.0 – 1.0)	1.0 (0.0 – 1.0)	1.0 (1.0 – 1.0)

* Significantly different ($p < 0.05$) when compared with sedentary individuals.

Regarding PREDIMED ($F_{(2,52)} = 0.53$, $p = 0.597$, $\eta^2 = 0.02$), no significant main effects were found between groups (soccer players = 6.8 ± 2.2 , physically active individuals = 7.5 ± 1.9 , sedentary individuals = 7.3 ± 2.4). In terms of PREDIMED categories, Pearson's chi-square test did not reach statistical significance ($\chi^2_{(4)} = 0.91$, $p = 0.923$). Most participants were classified within the average adherence category (soccer players = 60%, physically active individuals = 72.2%, sedentary individuals = 58.8%), while only a small percentage was classified as high adherence (soccer players = 15%, physically active individuals = 11.1%, sedentary individuals = 17.6%).

Welch's ANOVA revealed no significant main effects for MEQ ($F_{(2, 31.05)} = 0.061$, $p = 0.941$, $\eta^2 = 0.002$) between groups (soccer players = 51.6 ± 5.9 ; physically active individuals = 50.9 ± 7.7 ; sedentary individuals = 51.8 ± 11.4). For MEQ categories, no significant differences were observed between soccer players, physically active and sedentary individuals ($\chi^2_{(6)} = 10.56$, $p = 0.103$). Most participants were identified as neither chronotype (soccer players = 85%; physically active individuals = 77.8%; sedentary individuals = 47.1%). Few participants were classified as moderately morning (soccer players = 10%; physically active individuals = 16.7%; sedentary individuals = 17.6%) and moderately evening chronotype (soccer players = 5; physically active individuals = 5.6%; sedentary individuals = 23.5%).

No significant correlations were found between PSQI score and PREDIMED score in groups (soccer players: $r = -0.014$, $p = 0.952$, 95% CI = -0.454 to 0.431 ; physically active: $r = 0.415$, $p = 0.087$, 95% CI = -0.065 to 0.739 ; sedentary individuals: $r = -0.166$, $p = 0.523$, 95% CI = -0.599 to 0.342), and between PSQI score and MEQ score in soccer players ($r = -0.112$, $p = 0.638$, CI = -0.528 to 0.348) and physically active individuals ($r = -0.210$; $p = 0.403$, 95% CI = -0.616 to 0.285).

A negative correlation ($r = -0.514$, $p = 0.035$, 95% CI = -0.797 to -0.044) was found between PSQI score and MEQ score in sedentary individuals (Figure 1), indicating that poorer sleep quality was associated with a greater evening preference in sedentary individuals.

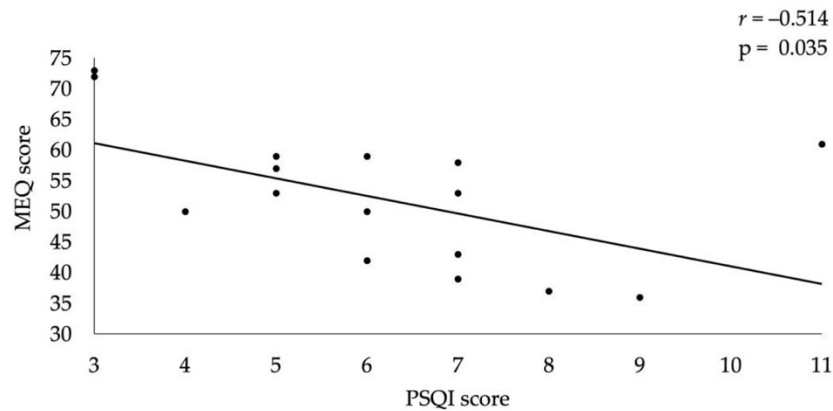


Figure 1. Scatter plots showing the relationships between Pittsburgh Sleep Quality Index (PSQI) score and Morningness–Eveningness Questionnaire (MEQ) score in sedentary individuals. Pearson correlation coefficients (r) and corresponding p-value (p) are displayed in the figure.

4. Discussion

This study investigated the sleep quality, adherence to the Mediterranean diet, and chronotype among amateur soccer players, compared with physically active and sedentary individuals. Moreover, exploratory correlation analyses were conducted to examine the associations between sleep quality, dietary adherence, and chronotype within each group. Overall, the results indicate differences between amateur soccer players, physically active individuals, and sedentary peers, which should be interpreted as exploratory.

Competitive sports can introduce stressors such as high training loads, anxiety, travel, and matches [10,11], which may negatively impact sleep quality [47]. In our study, amateur sport and high physical activity level were associated with a good sleep quality, with soccer players and physically active individuals reporting lower PSQI scores than sedentary individuals. The good sleep quality observed in soccer players contrasts with the sleep difficulties exhibited by elite or professional athletes [47]. In fact, there is evidence of vulnerability to sleep disruptions in sport practices, which could be due to factors such as training volume schedules, irregular daily routines, pre-competition anxiety, and early-morning training [48], more pronounced in professional than amateur athletes. These contextual differences likely explain the more favorable sleep patterns observed in our sample of amateur soccer players. In line with this, a previous study [16] on female student-athletes found poorer sleep quality compared to sedentary individuals. This different result could be attributed to the demands of balancing academic stress and high training loads, which may not be present in athletes competing at an amateur level. Therefore, amateur soccer may represent a sport context that does not excessively impair sleep quality compared with professional athletic settings. Analyzing the seven PSQI components individually allowed us to identify which specific aspects of sleep contributed to the differences in PSQI scores. Specifically, the better sleep quality in soccer players was primarily reflected in differences in sleep duration and subjective sleep quality compared to sedentary individuals. These findings suggest that structured and regular sport participation may positively influence both the quantity and perceived quality of sleep, possibly through improved behavioral routines and enhanced sleep hygiene.

Findings also indicated the absence of a significant main effect of physical activity level on adherence to the Mediterranean diet. Although previous studies [16,49,50] have highlighted the benefits of the Mediterranean diet on athletic performance and recovery, our results suggest that amateur soccer players do not exhibit particularly high adherence to this dietary pattern, likely because they are not subject to structured nutritional planning. However, this interpretation remains speculative, as nutritional support and dietary guidance were not evaluated. Furthermore, all participants lived in the same sociocultural context, which may have contributed to a similar dietary pattern regardless of physical activity levels. As a result, most participants reported average adherence, with a relatively small number of individuals showing high adherence to the Mediterranean diet. These findings could suggest that sport participation alone may not be sufficient to foster healthier nutritional habits, reinforcing the need for targeted nutrition education programs within amateur settings [51,52]. Similar consideration can be made regarding chronotype. Most participants were classified as neither type, suggesting limited variability in circadian preference. This homogeneity may reflect common context and academic schedules.

Correlation and regression analyses provided additional insights into the role of sleep quality in health-related behaviors. The lack of significant correlations between PSQI and PREDIMED scores across groups may be due to the predominance of average adherence to the Mediterranean diet. Conversely, the negative relationship between sleep quality and chronotype observed in sedentary individuals suggests that evening preference was linked to poor sleep quality, whereas an earlier morning preference was associated with good sleep quality. Epidemiological studies [53–56] have consistently linked a circadian preference for eveningness with multiple health risks, including sleep problems, poor mental health, and reduced life expectancy. Evening-type individuals may experience shorter sleep duration due to delayed sleep onset and fixed morning activities, further promoting circadian misalignment [15,57]. Although amateur sport participation and physical activity engagement showed a good sleep quality, no differences in chronotype were demonstrated between groups. This suggests that the observed differences in sleep quality may not reflect a change in circadian preference, but rather be related to more regular daily routines and a high sleep requirement induced by fatigue from exercise. In this context, structured training schedules may help maintain more regular sleep–wake patterns without changes in circadian preference. This interpretation is further supported by the relationship between chronotype and sleep quality, which was evident only in sedentary individuals. Regular engagement in physical activity and amateur sport may therefore reduce the negative impact of evening preference on sleep quality, rather than change circadian preference. In fact, exercise can regulate the expression of clock genes, synchronize the circadian rhythm, by enhancing sleep hygiene and promoting earlier sleep onset [58,59].

The present study suggests that amateur soccer practices are associated with a lower PSQI score than sedentary individuals. In contrast, adherence to the Mediterranean diet does not differ across groups. These results suggest that good sleep quality can be observed in amateur soccer contexts, while also indicating the need to improve adherence to the Mediterranean diet within this population. However, this study presents several limitations. Firstly, given the small sample size, the present study should be considered exploratory. In particular, considering the number of correlations performed, no formal correction for multiple testing was applied, and results should therefore be interpreted with caution. Moreover, sleep quality and dietary habits were assessed using self-reported questionnaires, which may have introduced subjective bias and did not allow objective evaluation of sleep parameters or nutritional intake. Thirdly, the cross-sectional design allows the identification of associations but prevents conclusions regarding causal

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relationships between soccer and physical activity practices, sleep quality, chronotype, and dietary habits. Future longitudinal studies are needed to understand the role of sleep quality to better understand the temporal relationship between sleep quality, physical activity, and circadian preferences. Lastly, potential confounding variables such as stress, caffeine and alcohol intake, and electronic device use before bedtime were not controlled, which could have influenced sleep and chronotype outcomes. Therefore, future studies should aim to separate the roles of sedentary time and physical activity on health-related outcomes, ideally using larger samples, accounting for additional cofounders, using objective activity monitoring, and stratifying participants by both sitting time and IPAQ categories.

5. Conclusions

In summary, this study highlights the benefits of soccer practices in amateur categories, where participants reported a better sleep quality than their sedentary peers. These findings suggest that the amateur soccer context may have a positive influence on sleep quality, in contrast to the sleep disturbance reported in research on professional athletes. The lack of a significant difference in adherence to the Mediterranean diet, combined with a predominance of average adherence level, suggests that amateur soccer players may require structured nutrition education to achieve the health and performance benefits traditionally associated with the Mediterranean diet.

The absence of differences in chronotype across groups suggests that the good sleep quality observed in amateur soccer players and physically active individuals is not attributable to changes in circadian preference. Instead, these differences are more likely related to the lifestyle associated with regular physical activity. This interpretation is further supported by the relationship between chronotype and sleep quality, which was evident only in sedentary individuals. This result suggests that physical activity and amateur sports may mitigate the adverse effects of evening preference on sleep quality.

Overall, these results indicate that while the amateur soccer context may contribute to sleep health, it does not necessarily promote a healthy dietary pattern or circadian preference.

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Informed Consent Statement: Written informed consent was obtained from all participants.

Data Availability Statement: Data available in a publicly accessible repository. The original data presented in the study are openly available in GitHub (GitHub Inc., San Francisco, CA, USA) at: <https://github.com/ccortis/DataSleep.git>

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Abbreviations

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The following abbreviations are used in this manuscript:

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IPAQ	International physical activity questionnaire
HEPA	Health-enhancing physical activity
MET	Metabolic equivalent task
BMI	Body mass index
PSQI	Pittsburgh sleep quality index
PREDIMED	Prevención con dieta mediterránea
MEQ	Morningness–eveningness questionnaire
%	Percentage
ANOVA	Analysis of variance
η^2	Eta squared
CI	Confidence interval
SE	Standard error
χ^2	Chi-square
<i>r</i>	Pearson’s correlation coefficients
<i>p</i>	P-value

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CONCLUSION

The present doctoral research investigated how key lifestyle behaviors, such as physical activity, body image, exercise dependence, adherence to Mediterranean diet, sleep quality, and chronotype, interact in young adults engaged in different sport and physical activity contexts. In particular, this doctoral research had three different aims:

- I. To examine the effects of lifestyle, including team sport participation, physical activity levels, and high sitting time behavior, on body image and exercise dependence.
- II. To compare female volleyball student-athletes with non-athlete students with a high sitting time to determine whether adherence to the Mediterranean diet, sleep quality, chronotype, and body image differed between the two groups.
- III. To investigate the sleep quality, adherence to the Mediterranean diet, and chronotype among amateur soccer players, compared with physically active individuals and individuals with high sitting time behavior.

The doctoral research adopted sex-specific samples across different studies as a methodological and theoretical choice. In particular, body image and exercise dependence are well-documented to be influenced by sex, sport type, and shaped by sociocultural norms [6,30]. We considered different sports for each sex, soccer for males and volleyball for females, being the most popular within the Italian young adult population [20]. This approach was intentional for our study design, allowing us to have groups that were representative of the typical sports played in Italy by sex. Moreover, soccer and volleyball are characterized by distinct aesthetic demands, training modalities, and social representations. Therefore, this population could offer an accurate representation of the actual situation, providing useful information regarding body image, exercise dependence, diet adherence, sleep quality, and chronotype, taking into account the typical sports played in Italy by sex. However, this choice could be a potential confounding factor, as the observed differences in body image and exercise dependence may have been influenced not only by the type of sport but also by sex.

In line with our first hypothesis, the findings suggested that sex and the level of physical activity significantly affected participants' body dissatisfaction across the measured indices. A total of 42.74% of the variance in the body dissatisfaction indices could be attributed to sex and physical activity level differences among the groups, highlighting the substantial effect of physical activity and sex differences on body image perceptions. In particular, differences in body dissatisfaction were observed between the soccer players' group and volleyball players' group, as well as between the physically active males and both the volleyball players and females with high sitting time behavior, indicating that the type of sport, the level of physical activity, and sex play a role in influencing body image perceptions. Moreover, physical activity also emerged as having an impact on exercise dependence, with 68.88% of the variance attributable to the different levels of physical activity among the groups, indicating a strong relationship between physical activity levels and the tendency toward exercise dependence.

In line with our second hypothesis, the findings highlighted that although student-athletes demonstrated significantly higher adherence to the Mediterranean diet, they also reported poorer sleep quality compared to their peers with high sitting time behavior. This paradox underscores the complexity of lifestyle behaviors among dual-career individuals, emphasizing how concurrent academic and athletic demands might compromise crucial psychophysiological aspects.

Regarding the third hypothesis, the findings indicated that soccer practices in amateur categories, where participants reported a better sleep quality than their peers with high sitting time behavior, while a relationship between sleep and chronotype was found in individuals with high sitting time behavior.

Sports can be classified as "aesthetic/lean" and "nonaesthetic/non-lean" [64], where body dissatisfaction seems to be higher in weight-sensitive (i.e., aesthetic) athletes, such as ballet dancers, who seem to be more dissatisfied than others due to the perception of being overweight with a greater desire to be thin, especially in female dancers. Although volleyball does not fall into this category, its training, focusing on upper limb strength [65], increases muscle mass in these areas, which may result

in physiques differing from traditional female aesthetic ideals. Soccer training requires extensive aerobic and anaerobic work [66], developing physiques more aligned with society's ideals, which could positively influence soccer players' body image. The benefits of soccer practices on body image have been documented in the literature [28,29] investigating the effects of a soccer training program on body composition and body image satisfaction among preadolescents, reporting improvements in body composition and decreases in body dissatisfaction, suggesting the positive benefits of this sport on physical and psychological health. Therefore, given the physical demands of volleyball, players might experience more body dissatisfaction if they do not identify with their ideal body type.

Although regular physical activity, exercise, and sports participation at various competitive levels are important for improving and maintaining mental and physical health, increasing the amount of physical training could lead to compulsive behaviors or addiction [15,17,35]. Our findings confirm that the prevalence of exercise addiction risk is generally higher among regular exercisers than in the general population [35,67]. In fact, the females with high sitting time behavior had lower scores in the different dimensions of exercise dependence than the physically active males and volleyball players, highlighting the paradoxical phenomenon where long sitting time, despite the general health risks associated, could have a protective role on exercise behavior. However, these dissimilarities were not found in the males with high sitting time behavior, highlighting sex differences in exercise dependence. The literature [17–19] suggests that males generally score higher in exercise dependence than females, probably due to social dynamics, where males have greater motivation to exercise and increase the amount and intensity of training, independent of their sitting time. It might be possible that, for males, exercise is essential for obtaining a strong and muscular physique, whereas females may find that exercise may not yield their desired (thin) physique [19], which is not achieved unless through caloric restriction in the dietary regimen.

Moreover, volleyball players had higher values of exercise dependence than females with high sitting time behavior, indicating how sport commitment represents a risk of maladaptive exercise behaviors similar to those found in younger athletes. Due to their competitive nature and rigorous

training demands, sports can lead athletes to push their limits to improve performance, which can result in an obsessive and compulsive relationship with their sport [13,31,35,68,69]. Although the volleyball players demonstrated differences from the females with high sitting time behavior in several dimensions of the EDS, these dissimilarities were not present in the soccer players, where individual-sport athletes had a higher risk of exercise dependency than team-sport ones. A systematic review [35] showed that distinct factors could play roles in the development of exercise dependence in sport practices, such as obsessive passion and dedication, social physique anxiety, eating disorders, and weight and shape concerns [35]. Weight concerns and BD could be relevant factors explaining the higher scores observed in several dimensions of exercise dependence in the volleyball players' group. This might suggest an association between BD and exercise dependence, where individuals with negative perceptions of their body image may choose to excessively exercise as a method to enhance their physical appearance and achieve their aesthetic ideals [70,71]. Body dissatisfaction could be a relevant factor explaining the higher scores observed in several dimensions of exercise dependence in the volleyball players. This might suggest an association between body dissatisfaction and exercise dependence, where individuals with negative perceptions of their body image may choose to excessively exercise as a method to enhance their physical appearance and achieve their aesthetic ideals.

Adherence to the Mediterranean diet showed different findings across studies. The second study indicated that student-athletes showed higher adherence to the Mediterranean diet than non-athlete students with high sitting time behavior, which is in line with existing research indicating that athletes, especially within structured team settings, often have greater nutritional awareness and receive specific dietary guidance [72]. Participation in sports likely encourages beneficial health behaviors, including regular meals, appropriate nutrient timing, and selection of whole foods, driven by performance needs. However, the results could also be due to contextual factors, such as food availability and the competitive season. Environmental access (team routines, canteens/meal plans, nutritionist guidance) can facilitate the Mediterranean adherence diet, independent of individual

knowledge about its health benefits. Moreover, the athletes were assessed in-season, when diet is often more tightly controlled for performance, although athletes could have a different approach to diet during their off-season. This is consistent with the idea that athletes may be more aware of nutritional needs or have access to a more structured diet to improve performance. Instead, amateur soccer players, although engaged in regular training, were not subject to structured nutritional planning. Although previous studies [37,73] have highlighted the benefits of the Mediterranean diet on athletic performance and recovery, our results suggest that amateur soccer players do not exhibit particularly high adherence to this dietary pattern, likely because they are not subject to structured nutritional planning. However, this interpretation remains speculative, as nutritional support and dietary guidance were not evaluated. Furthermore, all participants lived in the same sociocultural context, which may have contributed to a similar dietary pattern regardless of physical activity levels. As a result, most participants in the third study reported average adherence, with only a small number showing high adherence to the Mediterranean diet. These findings could suggest that amateur sport participation alone may not be sufficient to foster healthier nutritional habits, reinforcing the need for targeted nutrition education programs within amateur settings. Therefore, structured nutrition education is needed to reach the health and performance benefits of the Mediterranean diet [74,75].

Sleep quality emerged as a key factor in sport practices, depending on context and sex. Female volleyball student-athletes reported poorer sleep quality than peers with high sitting time behavior. This finding supports the dual-career paradox, underscoring the complexity of lifestyle behaviors among dual-career individuals and emphasizing how concurrent academic and athletic demands might compromise crucial psychophysiological aspects. The poorer sleep quality observed among student-athletes raises concerns, since sleep plays a crucial role in physical recovery, cognitive function, and emotional regulation [27,76]. While student-athletes are typically considered healthy, these findings support increasing evidence of vulnerability to sleep disruptions due to factors like training volume schedules, irregular daily routines, pre-competition anxiety, and academic stress [77]. This unexpected pattern suggests that, although athletic participation may confer advantages in

other health domains, it can also expose student-athletes to sleep-specific risk factors due not only to the dual-career demands, but also from requirements of specific sports, such as early-morning training, competition-related anxiety, or greater recovery needs, which could further increase the risk of reporting sleep disturbances. Moreover, early morning practices and evening competitions may misalign with natural circadian rhythms, particularly in those with an evening chronotype, potentially reducing sleep duration and efficiency [78]. Although previous studies indicate that Mediterranean diet adherence may improve sleep quality [32], our findings suggest that such beneficial effects may be reduced by behavioral and environmental stressors associated with dual-career lifestyles. It is possible that dietary benefits alone cannot fully offset chronic disruptions caused by conflicts between academic/athletic responsibilities and biological sleep preferences. In contrast with these results, amateur sport participation was associated with sleep quality, largely due to longer sleep duration and more favorable subjective sleep ratings, suggesting that sport performed at an amateur level may offer health benefits without the high stress of professional competition (travel, anxiety, pressure). These findings support increasing evidence of vulnerability to sleep disruptions, which could be due to factors like training volume schedules, irregular daily routines, pre-competition anxiety, and early-morning training [77], more pronounced in professional and student-athletes than amateur athletes.

Furthermore, no significant differences were observed between groups regarding chronotype scores, suggesting that external factors, like academic and training schedules, may have a greater impact on sleep than intrinsic biological rhythms. In both studies, most participants were classified as neither type, suggesting limited variability in circadian preference. As highlighted previously during the conclusion, all participants in the third study lived in the same sociocultural context, which may have contributed to a similar dietary pattern regardless of physical activity levels. This homogeneity may reflect common context and academic schedules.

The negative relationship between sleep quality and chronotype observed in individuals high sitting time behavior suggests that evening preference was linked to poor sleep quality, whereas an earlier morning preference was associated with good sleep quality. Epidemiological studies

[45,79,80] have consistently linked a circadian preference for eveningness with multiple health risks, including sleep problems, poor mental health, and reduced life expectancy. Evening-type individuals may experience shorter sleep duration due to delayed sleep onset and fixed morning activities, further promoting circadian misalignment [33,81]. Although amateur sport participation and physical activity engagement showed a good sleep quality, no differences in chronotype were demonstrated between groups. This suggests that the observed differences in sleep quality may not reflect a change in circadian preference, but rather be related to more regular daily routines and a high sleep requirement induced by fatigue from exercise. In this context, structured training schedules may help maintain more regular sleep–wake patterns without changes in circadian preference. This interpretation is further supported by the relationship between chronotype and sleep quality, which was evident only in individuals with high sitting time behavior. Regular engagement in physical activity and amateur sport may therefore reduce the negative impact of evening preference on sleep quality, rather than change circadian preference. In fact, exercise can regulate the expression of clock genes, synchronize the circadian rhythm, by enhancing sleep hygiene and promoting earlier sleep onset [82,83].

Although the present doctoral research used a cross-sectional design, the findings can be interpreted within an integrative framework linking psychosocial, behavioral, and physiological pathways. Sports practices, physical activity, and sitting time behavior appear to play a central role within this framework, influencing other health-related domains. Although physical activity, exercise, and sport have different benefits for physical and mental health, the type of sport, context, and sex can modulate these benefits. Individuals who engage in regular physical activity and sport more closely resemble the aesthetic ideal of a fit physique with respect to nonexercisers, improving body image. However, sport type could impact the body image, where female volleyball players could reach a physique that is too muscular and not conforming to traditional aesthetic norms of femininity. Moreover, individuals with negative perceptions of their body image may choose to excessively exercise as a method to enhance their physical appearance and achieve their aesthetic ideals. When sport becomes competitive, with high training load and academic stress, or to improve own physique,

it may have a negative effect on health. This compulsive engagement in exercise may contribute to insufficient recovery, which can negatively affect sleep quality and overall well-being.

High sitting time behavior not only reduces energy expenditure but could have an impact on behavioral and psychological outcomes. Prolonged sitting time may increase exposure to social media and screen-based content that reinforces unrealistic body ideals, increasing body dissatisfaction, particularly in females. At the same time, it may lack structured daily routines, increasing vulnerability to chronotype-related sleep disturbances, as observed in individuals with high sitting time behavior. While evening chronotype is associated with a poor sleep quality, particularly in individuals with high sitting time behavior, amateur sport and regular engagement in physical activity may mitigate the negative impact of evening preference on sleep through more structured routines and exercise-induced fatigue, without necessarily altering circadian preference.

This doctoral research demonstrates that the relationship between physical activity, sport practices, and well-being in young adults is complex and dependent on the context, requiring a multidimensional approach. While engagement in physical activity and sport can support positive body image and sleep quality, these benefits depend on the context and may be attenuated or reversed under conditions of excessive training demands, dual-career stress, or high sitting time behavior. Although physical activity and engagement in sports positively contribute to body image perception, particularly in males, excessive exercise can reduce these health benefits, especially in females.

Sleep quality could be influenced by contextual sport demands, representing a vulnerability area among student-athletes, whereas amateur sport practices may offer protective effects through regular routines. However, amateur soccer players could not demonstrate a high adherence to the Mediterranean diet, underscoring the need for targeted nutritional education.

Thus, a careful balance between exercise and mental health is essential, particularly within competitive sports contexts. Achieving such a balance can help reduce the risks of excessive dependency on exercise and having a healthy approach toward physical activity and sports. Moreover, this doctoral research highlights a paradoxical lifestyle among female student-athletes and amateur

soccer players, emphasizing the importance of integrative health strategies to address both nutrition and sleep, as well as body image concerns. This research provides more insights into personalizing approaches for promoting healthy exercise habits across different populations and sport disciplines. By understanding these findings, it will be possible to develop interventions that balance physical activity and mental health, particularly in competitive sports contexts.

The strength of this doctoral research is its multidimensional approach, integrating psychological, behavioral, and lifestyle factors within different samples. The inclusion of student-athletes, amateur athletes, physically active individuals, and individuals with high sitting time behavior allowed examination of different lifestyle factors, body image, exercise dependence, diet adherence, sleep quality, and chronotype. The consistent use of validated instruments and the reporting of effect sizes further strengthen the interpretability of the findings. However, this doctoral research presents several limitations, including a relatively small sample size, for the second and third study, restricted to the university population and amateur soccer players, potentially limiting generalizability. Additionally, these cross-sectional studies highlighted differences between body image, exercise dependence, sleep quality and adherence to the Mediterranean diet, between different samples, but it cannot determine cause-and-effect relationships. Another limitation is that we considered different sports for each sex (soccer for males and volleyball for females). This approach was intentional for our study design, allowing us to have groups that were representative of the typical sports played in Italy. However, this choice could be a potential confounding factor, as the observed differences in body image and exercise dependence may have been influenced not only by the type of sport but also by sex. Moreover, we acknowledge that differences in physical activity levels within the individuals with high sitting time behavior could have introduced some heterogeneity, which should be considered when interpreting the findings. Therefore, future studies should aim to separate the roles of sitting time and physical activity and their effect on health-related outcomes, ideally using larger samples, objective activity monitoring, and stratifying by both sitting time and IPAQ categories.

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Congress Abstract:

Short-Term Effects of Exercise on Body Image

Festino, E., Papale, O., Cortis, C., Fusco, A.

28th Annual Congress of The European College of Sport Science

Conventional Print Poster: CP-MH07 Obesity/Weight loss I

SHORT-TERM EFFECTS OF EXERCISE ON BODY IMAGE

FESTINO, E., PAPALE, O., CORTIS, C., FUSCO, A.

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INTRODUCTION: Body image (BI) is a multidimensional construct focused on body's appearance and function, representing how subjects see, feel, think and behave regarding their bodies (1). Weight dissatisfaction and negative body image

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28th ANNUAL CONGRESS OF THE EUROPEAN COLLEGE OF SPORT SCIENCE

CP-MH07 Obesity/Weight loss I

are predictors of health-related problems such as depression, weight control and eating disorders. Since the regular practice of physical activity (PA) has physical and psychological health benefits, it could also play a key role in improving BI. Therefore, this study aimed to evaluate the short-term effects of exercise on BI in physically active adults.

METHODS: Twenty-one physically active adults (age: 30 ± 12.9 yrs; mass: 66.4 ± 12.4 kg; height: 167.6 ± 6.8 cm; body mass index (BMI): 23.55 ± 3.7 kg/m²) participated in the study. Before (pre) and after (post) their individual not structured workout, the Body Image Dimensional Assessment (BIDA) questionnaire (2) was administered. BIDA assesses the subjective and emotional dimensions of BI by means of a neutral silhouette-based scale, ranging from 1.8 to 5.2. Participants had to indicate their perceived and ideal body shape, the most appropriate body shape for their peers and the most appreciated body shape by the opposite sex. The Body Dissatisfaction Index (BDI) was estimated through the mean of the absolute values of Body Dissatisfaction, Sexual Body Dissatisfaction and Comparative Body Dissatisfaction. The BDI ranges from 0 to 100AU, with people scoring > 30 considered at risk of BI disorders. At the end of their individual workout, to evaluate the overall exercise intensity, rating of perceived exertion (RPE) was collected using the Borg category-ratio-10 scale. A paired t-test was used to examine the effects of a single workout on BDI. Statistical significance was set at $p < 0.05$.

RESULTS: The mean RPE at the end of the workout was 6.8 ± 1.9 AU indicating a vigorous intensity session. No significant differences ($p = 0.61$) in BDI were found between pre (16.8 ± 3.3 AU) and post (17.5 ± 6.9 AU) workout.

CONCLUSION: Although most BDI participants' scores changed after the workout, no significant differences emerged between pre and post values. It might be assumed that BI is not immediately affected by a single workout session. Probably, to improve physical wellness and psychological benefits to observe changes in BDI, a longer period of training is required. In addition, the participants' post exercise responses could have been influenced by the knowledge of their previous answers due to the short time between the pre and post administration. Moreover, since participants had a normal range of BMI and were physically active, future researches could investigate the effect of a single workout session on BI in individuals with different BMI categories or sedentary individuals.

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Congress Abstract:

How Athletic pursuits shape body image in young adults

Festino, E., Papale, O., Carlino, M., Cortis, C., Fusco, A.

XIV Congresso Nazionale della Società Italiana delle Scienze Motorie e Sportive

Sport Science for Health (2024) 20:S1–S180

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Sport Sci Health (2024) 20:S1–S180

Purpose: It is known that people living in rural or isolated communities spent more time in sedentary activities than those of urban ones.¹ The aim is to examine the impact of specific exercise modalities on physical, physiological, and psychological health outcomes in older adults living in maritime community.

Methods: A physical activity promotion project was developed in remote maritime area of the north-east Adriatic coast (Delta del Po region, Emilia Romagna, Italy). Forty-seven (47) older adults were involved in a dry-land and water exercise intervention promoted by a "Palestra della Salute" recognized by the Emilia Romagna Region and CONI.

Individuals were evaluated for anthropometric (weight, waist circumference, BMI) and functional (VO_{2peak} and lower limb fluids accumulation) variables. The adherence to the projects were assessed through the rate of participation at the activities proposed.

Results: The sample is constituted by 37 women and 10 men, the 29.6% normal weight, the 55.5% overweight and the 14.8% was obese. The adherence to the program was recorded in 70% ($n = 17$ exercise sessions). The walking test assessed an average value of estimated VO_{2peak} ranged from good to very good (23.8 ± 3.5 to 26.4 ± 3.7 ml/kg/min, $P = 0.009$). Weight reduction from 66.4 ± 9.9 to 65.7 ± 3.9 ($P = 0.006$). Finally, lower limb fluids accumulation significantly decreased from the baseline to 8-week (mean value right and left leg: ranged from 2402 ± 423 to 2348 ± 392 ml $p < 0.0001$).

Conclusions: A physical activity program combining both dry-land and water exercise sessions was effective in promoting active lifestyle even in remote maritime communities more subjected to sedentary behaviors. Cardiovascular fitness improvement and fluids accumulation reduction are potentially related to the transition from sedentary to active lifestyle, even in healthy subjects.

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How Athletic pursuits shape body image in young adults

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Purpose: Mental health is an important component of overall health, although concerns about body's appearance could affect mental health. Body image (BI) is a multidimensional construct focused on how subjects see, feel, think and behave regarding their bodies. Negative BI is predictors of health-related problems such as depression, weight control and eating disorders. Given the positive impact of sport practice, in particular team sport, on health, this study aimed to evaluate the effect of team sport practice on individual's BI.

Methods: Forty young adults (17 males, 23 females) were allocated in two groups: Team Sport Group (TSG = 20 team sport athletes) and Sedentary Group (SG = 20 sedentary individuals). To assess the subjective and emotional dimensions of BI, subjects were asked to complete the BI Dimensional Assessment (BIDA) questionnaire. BIDA is a neutral silhouette-based scale, ranging from 1.8 to 5.2. Participants had to indicate their perceived and ideal body shape, the most appropriate body shape for their peers and the most appreciated body shape by the opposite sex. Three direct indexes were then calculated: Body Dissatisfaction (BD), Sexual Body Dissatisfaction

(SxBD), Comparative Body Dissatisfaction (CBD). The scores can range between -100% and 100%. Positive values indicate that subjects currently rate their BI higher than idealized levels. To verify differences ($p < 0.05$) in BD, SxBD, CBD in team sport athletes compared to sedentary individuals a multivariate analysis of variance (MANOVA) was applied.

Results: TSG showed significant ($p < 0.05$) lower values for BD ($3.5 \pm 9.3\%$), SxBD ($-1.3 \pm 9.4\%$) and CBD ($-10.8 \pm 8.5\%$) with respect to SG (BD: $12.7 \pm 17.1\%$; SxBD: $10.7 \pm 18.3\%$; CBD: $4.3 \pm 24.7\%$).

Conclusions: Findings confirm the relevant role of sport participation in determining psychological benefits, such as a person's perceptions of body. The TSG reported better perceived BI than sedentary counterparts. Scores of BD and SxBD were higher (positive) in SG than TSG, indicating that perceived body shape of athletes is similar to the ideal and the most appreciated body shape by the opposite sex. Conversely, scores of CBD were lower (negative) in TSG than SG, indicating that perceived body shape is different than the most appropriate body shape for their peers. This difference could be due to athletes tending to resemble the aesthetic ideal of a healthy and appealing physique, which is not achieved by their peers.

Physical performance in masters' students in sport sciences related to the learning approach

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Purpose: Minimum levels of physical activity (PA) prescribed by the World Health Organization are achieved through a variety of modalities. Some are characterized by a cognitive approach, which aims to improve physical skills through a reproductive style, while others are characterized by an ecological-dynamic approach, which optimizes heuristic learning through a productive style. Currently, kinesiology do not give due importance to the effects on practice levels of different teaching-learning methodology in the two different teaching methods: prescriptive teaching and heuristic learning. The objective is to measure levels of physical performance in the category of future sports kinesiology and to test whether significant relationships exist between the effects of exercise and the type of approach to learning following individual PA.

Methods: Sample consists of 51 students attending the Master's degree course in Sports Science at the University of Salerno to whom a question was preliminarily administered to divide them into two groups: cognitive (CG) and ecological dynamic (EDG) based on the approach used in PA practice. A battery of quantitative tests was then administered: squat jump (SJ), counter movement jump (CMJ), free arms counter movement jump free arms (FA-CMJ), stiffness test (ST). Finally, a questionnaire was administered with Google Forms containing questions on the following topics: movement mode from one place to another, weekly PA practice and continuous PA practice. Subsequently, the collected data were processed using SPSS software with Chi-square and Student's t-tests for independent samples to verify relationships between variables and differences between performance levels.

Results: 100% ($n = 38/38$) of the respondents used a motorized vehicle every day; 37% of CG and 26% of EDG used motorized vehicles at least once a week ($P < .05$; Cramer V, .591); Bicycle use is very low in both groups and there is no association between group membership and bicycle use ($P > .05$); only 5% of CG and 26% of EDG walked for the entire week ($P = < 0.05$; Cramer V = 0.609); 100% of CG and 79% of EDG practiced PA continuously ($P < 0.05$;

Congress Abstract:

Exercise Dependence in Team Sport Athletes and Fitness Activities Participants

Festino, E., Papale, O., Carlino, M., Di Rocco, F., Cortis, C., Fusco, A.

2024 Annual Meeting of the American College of Sports Medicine

Medicine & Science in Sports & Exercise

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Exercise Dependence In Team Sport Athletes And Fitness Activities Participants

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(No relevant relationships reported)

PURPOSE: Although regular physical Activity (PA) has positive effects on mental and physical health, excessive exercise could have adverse effects. Exercise dependence (ED) is characterized by excessive training leading to physiological and psychological symptoms. Since excessive exercisers show higher ED risk compared to individuals with lower activity levels, this study aimed to investigate individual's ED levels in team sport athletes and people engaging in fitness activities (FA).

METHODS: Seventy adults (age: 29 ± 10.8 yrs) were allocated in two groups: Team Sport Group (TSG=36 team sport athletes) and FA Group (FAG=34 FA participants). The Exercise Dependence Scale (EDS-21), measuring on a 6-point Likert scale Withdrawal, Tolerance, Reductions in Other Activities, Lack of Control, Continuance, Intention Effects and Time dimensions, was used to assess ED. Mann-Whitney U-test was applied to verify differences ($p < 0.05$) in EDS-21 dimensions

in TSG compared to FAG.

RESULTS: The results of Mann-Whitney U-test are show in Table 1.

Table 1. Mean, Standard Deviation (SD) and Median of EDS-21 dimensions in Team Sport Group and Fitness Activities Group.

EDS-21 dimensions	Team Sport Group		Fitness Activities Group	
	Mean \pm SD	Median	Mean \pm SD	Median
Withdrawal	9.06 \pm 4.09	9.00	9.03 \pm 3.32	10.00
Tolerance	12.03 \pm 3.79	11.50 *	9.71 \pm 3.68	9.50
Reductions in Other Activities	7.31 \pm 3.24	6.00 *	4.88 \pm 2.14	5.00
Lack of Control	7.75 \pm 3.92	7.50	6.59 \pm 3.87	5.00
Continuance	8.94 \pm 5.17	7.50 *	4.56 \pm 2.21	3.00
Intention Effects	8.19 \pm 4.11	7.00 *	6.12 \pm 2.69	5.50
Time	11.22 \pm 3.24	11.00 *	7.56 \pm 3.24	7.00

* $p < 0.05$ with respect to Fitness Activities Group.

CONCLUSIONS: Although risk of ED (scores > 14 for at least 3 of the 7 dimensions) was not found, TSG scored higher in five dimensions of the EDS-21, indicating a greater propensity to exhibit behaviors which could result in ED. Results could be explained by sport commitment of athletes, requiring large amounts of training to pursue outstanding sport performances, and social pressure, representing a risk for maladaptive exercise behaviors. Conversely, participants engaging in FA might prioritize personal enjoyment, well-being enhancement, and socialization. Findings suggest the need for careful monitoring and psychological support for athletes engaged in sports to prevent adverse effects on health of excessive exercise.

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Congress Abstract:

Body Image in Team Sports and Fitness Activities

Festino, E., Papale, O., Cortis, C., Fusco, A.

29th Annual Congress of The European College of Sport Science

Oral Presentations: OP-SH13 Psychology/Body Image

BODY IMAGE IN TEAM SPORTS AND FITNESS ACTIVITIES

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INTRODUCTION: Body image (BI) is a multidimensional construct encompassing how subjects perceive, feel, think and behave in relation to their own bodies. Negative BI is a predictor of health-related issues, including depression, anxiety

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29TH ANNUAL CONGRESS OF THE EUROPEAN COLLEGE OF SPORT SCIENCE

OP-SH05 Sport management and law II

and eating disorders. Considering the positive effects of physical activity (PA) and sports on health, this study aims to assess the influence of team sports (TS) and fitness activities (FA) on BI.

METHODS: Sixty-eight adults (age: 28.7 ± 10.3 yrs) were divided into two groups: TS Group (TSG=34), such as football and volleyball players, and FA Group (FAG=34), such as cross training and weight training participants. To assess the subjective and emotional dimensions of BI, participants completed the BI Dimensional Assessment (BIDA) questionnaire. Using a neutral silhouette-based scale ranging from 1.8 to 5.2, participants indicated their perceived and ideal body shape, as well as the body shape most appreciated by the opposite sex and their peers. Three direct indexes were calculated: Body Dissatisfaction (BD), Sexual Body Dissatisfaction (SxBD), and Comparative Body Dissatisfaction (CBD). Scores ranged from -100% to 100%, with positive values indicating that subjects rated their BI higher than their idealized levels. The Body Dissatisfaction Index (BDI) was calculated as the mean of the absolute values of BD, SxBD and CBD. The BDI ranged from 0 to 100%, with scores >30% considered at risk of BI disorders. To determine differences ($p < 0.05$) in BD, SxBD, CBD and BDI between TSG and FAG, unpaired t-tests were conducted.

RESULTS: TSG showed significant ($p < 0.05$) lower values for BD ($5.7 \pm 10.2\%$), SxBD ($-0.2 \pm 15\%$) and BDI ($9.6 \pm 5.8\%$) compared to FAG (BD: $13.5 \pm 16.8\%$; SxBD: $11.1 \pm 20.6\%$; BDI: $18.4 \pm 11.9\%$). While for CBD no significant difference ($p > 0.05$) was found between groups (TSG: $-6.4 \pm 11.7\%$; FAG: $-1.5 \pm 28.2\%$).

CONCLUSION: The findings highlight the significant effect of sports participation on body perception. Although neither group exhibited a risk of BI disorders (BDI <30%), highlighting the mental health benefits of PA regardless of its type, TSG reported a better perception of their BI compared to the FAG. BD and SxBD scores were higher in FAG than TSG, suggesting that athletes perceived body shape closely aligns with their ideal and the body shape appreciated by the opposite sex. These results might be attributed to differences in exercise prescription between the two groups. In fact, considering the competitive nature of sports, TSG could have a more rigorous exercise program monitoring than FAG, potentially leading to a physique that aligns with the aesthetic ideal of health and attractiveness. Therefore, controlling and monitoring for exercise frequency, duration, intensity, and type, might be associated with improved BI.

Congress Abstract:

Evaluating the Influence of Mediterranean Diet Adherence on Body Image Among Team Sport Athletes

Festino, E., Papale, O., Di Rocco, F., Cortis, C., Fusco, A.

XV Congresso Nazionale della Società Italiana delle Scienze Motorie e Sportive

Sport Science for Health (2025) 21 (Suppl 1):S1–S170

Sport Sci Health (2025) 21 (Suppl 1):S1–S170

S13

OC116 - EFFECTS OF CIGARETTE SMOKING ON THE CARDIOMETABOLIC KINETICS ONSET PHASES IN YOUNG, PHYSICALLY ACTIVE MALES

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Purpose: Cigarette smoking (CS) affects negatively the cardiovascular and respiratory function, by altering the sympathetic drive, impairing O₂ delivery, and increasing airways resistance and oxidative stress. These changes impact the cardiorespiratory and metabolic response to exercise. Although these abnormalities are reported in sedentary, middle-aged smokers (SM) with pulmonary disease, few and controversial studies focused on whether CS effects extend to young, physically active SM. Specifically, this study seeks to investigate the CS-related alterations on cardiorespiratory and metabolic kinetics during the on-phase of a moderate exercise.

Methods: Ten SM (age: 22 ± 2 yrs, body mass: 78 ± 6 kg, stature: 1.79 ± 0.07 m, 11 ± 5 cigarette/day for 6 ± 2 yrs; mean ± SD) and 11 non-smokers (CTRL; age: 23 ± 1 yrs, body mass: 78 ± 8 kg, stature: 1.80 ± 0.09 m) underwent an incremental test to determine maximum pulmonary oxygen uptake (V̇O₂max), after pulmonary function evaluation. They performed four step transitions to a 6-min moderate exercise (90% of the first ventilatory threshold). Expiratory ventilation (V̇E), V̇O₂ and heart rate (fH) response were fitted by a bi-exponential function to assess the amplitude (AMP) and the time constant (τ) of the cardiorespiratory and metabolic kinetics for both phase I and II.

Results: Despite similar static lung volumes, SM revealed lower peak expiratory flow (8.4 ± 1.8 vs 10.5 ± 1.8 l s⁻¹, respectively; P = 0.01) and maximum voluntary ventilation (168 ± 14 vs 191 ± 23 l min⁻¹, respectively, P = 0.01) compared to CTRL. At peak exercise, despite similar V̇O₂ (3384 ± 318 vs 3623 ± 333 ml min⁻¹; for SM and CTRL, respectively), SM reported lower mechanical power (253 ± 21 vs 278 ± 27 W, respectively; P = 0.01) and V̇E (125 ± 11 vs 139 ± 11 l min⁻¹, respectively, P = 0.02) compared to CTRL. Moreover, SM had earlier ventilatory thresholds (p < 0.05). During moderate exercise, SM showed a reduced V̇O₂ AMP of phase II (886 ± 301 vs 1111 ± 295 ml min⁻¹, for SM and CTRL, respectively; P = 0.05), longer τ in V̇O₂ of phase I (17 ± 9 vs 12 ± 4 s, for SM and CTRL, respectively; P = 0.03) and in fH of phase II (61 ± 18 vs 48 ± 13 s, for SM and CTRL, respectively; P = 0.03). **Conclusion:** These findings are compatible with early CS-related alteration in the cardiorespiratory and metabolic response to exercise even in young, healthy SM with relatively short smoking history. CS adverse effects, such as altered O₂ delivery, airway resistance and oxidative stress, may explain these results.

OC117 - EVALUATING THE INFLUENCE OF MEDITERRANEAN DIET ADHERENCE ON BODY IMAGE AMONG TEAM SPORT ATHLETES EVALUATING THE INFLUENCE OF MEDITERRANEAN DIET ADHERENCE ON BODY IMAGE AMONG TEAM SPORT ATHLETES

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Purpose: Considering the well-documented benefits of balanced nutrition on athletic performance, well-being and physical appearance, this study aimed to evaluate the adherence to the Mediterranean diet (MD) among team sport athletes (TSA) and explore its influence on body image.

Methods: 40 young TSA (age: 23.4 ± 3.8 yrs), were administered the 14-item PREDIMED questionnaire to analyze their adherence to the MD. Based on their total score, the TSA were categorized into LOW (≤ 5AU), AVERAGE (6–9AU) and HIGH (≥ 10AU) adherence to the MD. To evaluate individual body image, the groups completed the Body Image Dimensional Assessment questionnaire, consisting of 4 items that use a numeric scale alongside four silhouettes to quantify degrees of Body Dissatisfaction (BD), Sexual Body Dissatisfaction (SxBD), Comparative Body Dissatisfaction (CBD). The Body Dissatisfaction Index (BDI) was calculated as the mean of the absolute values of BD, SxBD and CBD, ranging from 0 to 100%, with scores > 30% indicating a risk of body image disorders. Frequency table was used to explore the distribution (%) of adherence to the MD among TSA. One-way ANOVA was applied to assess differences (p < 0.05) in BDI across MD adherence (LOW, AVERAGE, HIGH) groups.

Results: The majority of TSA achieved an average adherence to the MD (70%), while a smaller proportion reported either high (17.5%) or low (12.5%) adherence. Despite the varying levels of adherence, no significant differences (p = 0.35) in BDI were observed among the groups (LOW: 5.8 ± 3%; AVERAGE: 11.2 ± 8.2%; HIGH: 10.2 ± 6.6%).

Conclusions: Given the low percentage of TSA demonstrating high adherence to MD, findings highlight the need to enhance nutritional education strategies to promote benefits of MD. Results indicate that athletes may possess partial knowledge or apply MD principles inconsistently, suggesting they recognize some benefits although not fully adhere to the diet. While a risk of body image disorders was not shown in TSA (BDI < 30%), the lack of significant differences in BDI among groups could suggest that adherence to MD does not significantly influence perceptions of body image among TSA. However, findings may be influenced by the high concentration of TSA within the AVERAGE adherence group, potentially hiding the MD impacts on body image. Future studies should investigate the influence of the MD on body image using a more evenly distributed sample to clarify these effects.

Congress Abstract:

Does flow state predict heart rate during self-paced cycling exercise in low and high immersive virtual environments?

Festino, E., Papale, O., Hibbs, A., Cortis, C., Fusco, A., Sakalidis, K., Barry, G., Tempest, G., Hettinga, F.

German Exercise Science and Training Conference (GEST25)

International Journal of Sports Physiology and Performance (2025), 20 (Suppl 1), 1–31.

S12 FREE COMMUNICATIONS: VERBAL AND POSTER

German Basketball Association (DBB) synergized with Frankfurt sport scientists for scientific support in developing structural 3x3 specific athlete management. Two funded projects from the Federal Institute for Sport Science were launched; the first one to understand the structure of the game; the second one, still running, to optimize individual athlete management of each German 3x3 athletes (project name "in:prove"). This talk will summarize current findings from these 3x3 related projects. Concerning game structure, 3x3 athletes perform more medium- and high-intensity accelerations and decelerations, explosive efforts, jumps, and changes of direction (CODs) per min compared to 5 vs 5 Basketball. A test capturing 3x3 typical CODs was developed and validated. PCA elucidated that sprint and COD performance are independent in 3x3 athletes when using tests with multidirectional and short-range CODs. In 3x3 tournaments, with multiple games on one day, recovery in-between games - using tensiomyography - is essential. 3x3 male and female German squad athletes were performance tested (sprint, jumps, CODs, strength upper and lower body; Schmitz et al., 2024) suggesting that particularly in female athletes, high-profile performance predicted selection for the national junior squad. Blood samples, nutrition protocols, cognitive and motor testing, psychosocial questionnaires and sports-related genetic variants exhibited that 3x3 athletes have ergodic as well as non-ergodic multifactorial feature patterns just like athletes of other Olympic disciplines. This talk highlights findings from current research on this novel Basketball format 3x3. Also, aspects of 3x3 athlete counseling such as managing travel fatigue/jet lag in world-wide tournaments will be presented as well as individualized regimen for 3x3 athletes.

Cycling

Does flow state predict heart rate during self-paced cycling exercise in low and high immersive virtual environments?

Emanuel Festino, University of Cassino and Lazio Meridionale

Flow is an intrinsically rewarding state where individuals feel fully absorbed in an activity, experiencing high levels of control and ease, even during demanding exercise tasks. Virtual reality (VR) offers an immersive environment and when combined with exercise is recognized to improve the overall experience and enjoyment. However, it is not known if flow impacts the level of exercise intensity an individual may self-select using different types of VR. Therefore, the aim of the study was to explore the association between sub-components of the Flow State Scale (FSS) and heart rate (HR) during self-selected exercise in low and high immersive VR conditions. Nineteen participants (n = 10 male, n = 9 female; age: 32 ± 9 years; height: 169 ± 10 cm; weight: 68 ± 13 kg) completed 15-min of self-selected cycling exercise in four conditions - No VR and VR using a computer screen (Low Screen), room-projector (Low Room), and head-mounted display (High HMD). HR was recorded during exercise. After each session, participants completed the FSS, which measured nine dimensions: challenge-skills balance; merging of action and awareness; clear goals; unambiguous feedback; concentration on the task at hand; sense of control; loss of self-consciousness; transformation of time and autotelic experience. Separate ANOVAs with repeated measures assessed the effect of VR on HR, while linear regression analyzed the relationship between FSS sub-components and HR. A one-way ANOVA with repeated measures revealed no significant main effect of condition on HR (mean ± SD, range 125 - 130 ± 9 - 16 bpm; $F(3,54) = .83$, $p = .48$). However, separate regression analyses revealed that different sub-components of the FSS explained variance in HR depending on condition. In the No VR condition, transformation of time was positively associated with HR ($r = .63$, $R^2 = 0.36$, $B = 7.41$, $p = .004$). In the low-immersive VR conditions loss of self-consciousness was negatively associated with HR (Low Screen, $r = -0.510$, $R^2 = .26$,

$B = 12.34$, $p = .03$; Low Room, $r = -.56$, $R^2 = .31$, $B = 8.61$, $p = .014$). In the High HMD condition, action and awareness was positively associated with HR ($r = .65$, $R^2 = .42$, $B = 5.68$, $p = .003$). The findings indicate that flow states varied across VR conditions, influencing the level of self-selected exercise intensity. In the No VR condition, participants who felt a greater alteration in their perception of time worked harder. While, in the High HMD condition, those with a high awareness showed an increase of effort. In the low VR environments, the more self-conscious an individual was, the harder they worked. The findings indicate that specific sub-components of flow (a) are influenced by the level of VR immersion, and (b) contribute to how hard an individual chooses to work during self-selected exercise. Findings are important for exercise promotion, showing how VR can enhance engagement and effort by targeting specific flow states, improving adherence to exercise.

The effect of feedback on time trial performance in trained cyclists under normoxic and hypoxic conditions*

Alexander Törpel, German Swimming Federation

The aim of this study was to identify whether task-specific feedback influences cycling performance during self-paced time trials (TT) in normoxia and hypoxia. In a counter-balanced randomized order, twelve trained cyclists (age 41 ± 11 years, height 184 ± 6 cm, body mass 80 ± 10 kg) performed four 16.1 km TT, once with and once without feedback (F, nF) under normoxia (N) or hypoxia (H; FiO_2 16.5%, ~2500 m), yielding a total of four conditions: FN, nFN, FH, nFH. Participants were blinded to the environmental conditions. During the F conditions performance-related information were given to them on a screen, including elapsed time, distance, power output (PO), cadence, speed, gear setting, and heart rate (HR). For the nF condition, only elapsed distance was provided. In two preliminary sessions participants performed a graded exercise test to measure maximal aerobic power (MAP) as well as their lactate (La), HR, and rate of perceived exertion (RPE) profiles, one each in N and H, followed by a 16.1 km TT under N with full feedback for familiarization. The combination of feedback and oxygen availability influenced PO during the TT with interaction ($p = .043$, $\eta^2 = .194$) and condition ($p < .001$, $\eta^2 = .70$) effects. Mean PO was highest in FN (297 ± 25 W) followed by nFN (293 ± 25 W), FH (279 ± 27 W), and nFH (270 ± 21 W). Under N conditions mean PO was higher than in both H conditions: FN > FH $p = .004$; FN > nFH $p < .001$; nFN > FH $p = .001$; nFN > nFH $p < .001$. However, mean PO was similar between F and nF within N and H. PO was maintained between 80 and 90% of MAP from the start of the TT to 14km and increased up to 100 to 105% at 16 km in all conditions ($p < .050$). La and HR increased significantly (time effect: La $p < .001$, $\eta^2 = .81$; HR $p < .001$, $\eta^2 = .79$) and differed between the four conditions during the TT (condition effect: La $p = .02$, $\eta^2 = .25$; HR $p = .006$, $\eta^2 = .36$). Throughout the TT, the highest La were evident in FH which were higher than in both N conditions (FN $p = .005$, nFN $p = .02$), but not in comparison to nFH ($p = 1.0$). In regard of HR, the lowest mean HR was observed in nFH, but only significantly different from the conditions FN ($p = .02$) and FH ($p = .03$). RPE increased from 14 to 19 throughout all TT conditions ($p < .001$, $\eta^2 = .91$). Mean RPE was highest in FH compared with FN ($p < .001$) and nFH ($p = .003$). The provision of task-specific feedback did not influence TT performance (i.e. mean PO) under N or H. However, the performance was significantly affected by H compared to N, regardless of whether F or nF was given. Due to the greatest difference in performance occurred between FN and nFH, it appears that there may be a cumulative negative effect when nF and H are applied simultaneously. There was a higher performance effort registered under FH in terms of La and RPE, which could be due to the experience from the preliminary TT under N. That should be considered by practitioners when training or competing under H conditions.

Congress Abstract:

Sleep Quality and Body Image In Amateur Athletes And Sedentary People

Festino, E., Papale, O., Di Rocco, F., Cortis, C., Fusco, A.

XVI Congresso Nazionale della Società Italiana delle Scienze Motorie e Sportive

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Sport Sci Health

OC154 - SLEEP QUALITY AND BODY IMAGE IN AMATEUR ATHLETES AND SEDENTARY PEOPLE

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Purpose: Since sleep quality and body dissatisfaction influence mental health and physical performance in athletes and sedentary individuals, this study examined the effect of team sport participation and sedentary behavior on body dissatisfaction and sleep quality, also considering sex differences.

Methods: 72 participants (age: 23.3 ± 3.1 yrs) were allocated into four groups: female Volleyball players (VP, N = 16), male Football players (FP, N = 20), sedentary females (SF, N = 19), and sedentary males (SM, N = 17). Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), which provides a global score of sleep quality, with values > 5 indicating poor sleep. The Body Image Dimensional Assessment (BIDA), consisting of four silhouette-based items assessing Body Dissatisfaction (BD), Sexual BD (SxBD), and Comparative BD (CBD), was used to calculate the composite BD Index (BDI) as the mean of the absolute values of BD, SxBD, and CBD, expressed as percentage. One-way ANOVA was used to assess group differences ($p < 0.05$) in BDI and PSQI score. Pearson's correlation coefficients (r) were used to examine the relationships between PSQI and BDI scores within each group.

Results: Significant differences across groups emerged for BDI (FP: $8.2 \pm 4.9\%$; VP: $13.3 \pm 9.2\%$; SM: $13.7 \pm 7.6\%$; SF: $18.2 \pm 11.3\%$; $p = 0.006$) and PSQI (FP: 3.8 ± 1.3 ; SF: 4.9 ± 2.5 ; SM: 6.1 ± 2.1 ; VP: 6.2 ± 3.1 ; $p = 0.007$). Post hoc analysis showed lower ($p = 0.02$) PSQI values in FP than in SM and VP. For BDI, SF showed a higher value than FP ($p = 0.003$). Correlation analyses revealed a significant positive association between PSQI and BDI in the FP ($r = 0.52$, $p = 0.018$) and SF ($r = 0.5$, $p = 0.029$) groups.

Conclusions: SF had higher BDI than FP, indicating that a sedentary lifestyle and female sex may increase body dissatisfaction. VP and SM showed PSQI scores above the clinical threshold, indicating poor sleep quality. The absence of significant differences in PSQI scores between SF and VP suggests that amateur volleyball participation may not confer sleep quality benefits over a sedentary lifestyle in female individuals. Insufficient sleep-hygiene leaves female amateurs players with sleep deficits similar to sedentary controls, compromising recovery, performance, and psychosocial health. Additionally, the moderate correlations between sleep quality and body dissatisfaction in both FP and SF suggest a link between psychological well-being and sleep across activity levels, as a positive perception of one's own body may promote healthy behaviors, such as good sleep quality.

Acknowledgments: (non obbligatorio).

References: (non obbligatorio).

OC155 - SELF-EFFICACY, PHYSICAL FITNESS AND ENJOYMENT OF PHYSICAL ACTIVITY IN OLDER WOMEN

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Purpose: Activities of daily living are paramount to ensure a high quality of life. Moreover, self-efficacy and physical activity (PA) are recognized as two crucial factors for healthy aging. However, their interaction and the extent to which self-efficacy in activities of daily living correlates components of physical fitness and affective responses like enjoyment, are not yet fully understood. Therefore, this study aimed to investigate the relation between self-efficacy in daily activities, multiple components of physical fitness, and enjoyment of PA in a cohort of active older women.

Methods: 125 active and healthy females (age 76.8 ± 5.1 y; height 1.58 ± 0.06 m; weight 65.2 ± 13.0 kg; BMI 26.2 ± 5.0 kg/m²) were recruited. Self-efficacy on activity of the daily living was assessed with a 5-item Likert scale ad hoc questionnaire. Enjoyment of PA was measured with the PA Enjoyment Scale (PACES). Physical fitness was evaluated with the Senior Fitness Test (SFT) battery (30" Chair Stand, Back Scratch, 8-Foot-Up-and-Go, 30" Arm Curl, 6-Min Walk Test and Sit and Reach test) and with Handgrip Strength test. As part of a preliminary statistical analysis, Cronbach's α and McDonald's ω were used to evaluate the internal consistency of the self-efficacy questionnaire, while Pearson's correlation was used to examine the interactions between all the test results.

Results: The self-efficacy questionnaire showed high internal consistency (Cronbach's $\alpha = 0.883$; McDonald's $\omega = 0.910$). Self-efficacy was positively correlated with PACES ($r = 0.358$, $p < 0.001$). Furthermore, self-efficacy significantly correlated with most SFT components: 30" Chair Stand ($r = 0.319$, $p < 0.001$), Back Scratch ($r = 0.306$, $p < 0.001$), 8-Foot-Up-and-Go ($r = -0.333$, $p < 0.001$), 30" Arm Curl ($r = 0.195$, $p = 0.031$), and 6-Min Walk Test ($r = 0.194$, $p = 0.033$). No significant correlation was found with the Sit and Reach test ($p = 0.700$) and with Handgrip Strength test ($p = 0.098$).

Conclusions: In active older women, higher self-efficacy is associated with greater enjoyment of PA and better performance in strength, endurance, and agility, which may lead to an enhanced quality of life. These findings could inform the adaptation of educational and PA projects proposed by kinesiologists, suggesting that PA programs for older adults should account for both the physical and cognitive components of movement. Adopting such a cognitive embodiment perspective may be crucial for simultaneously enhancing physical fitness and self-efficacy, thereby contributing to healthy aging.

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