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Psychological Factors and Their Effect on the Health, Well-Being and Performance of Athletes

Edited by
Manuel Gómez-López, Antonino Bianco and Carlos Marques da Silva

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Contents

Preface to "Psychological Factors and Their Effect on the Health, Well-Being and Performance of Athletes"

Regular sports practice has a positive influence on the physical, mental, and psychological health of athletes at different levels and in a variety of contexts. Sports performance depends not only on the physical qualities of athletes, but also on psychological variables. In a competitive context, knowledge and manipulation of psychological variables such as attention, self-confidence, stress control, anxiety, motivation, cohesion, self-control or emotional self-regulation, moods, and interpersonal skills can influence the performance and health of an athlete.

Even playing sports can generate feelings of fear of failure and the emergence of feelings of shame, creating a degree of insecurity, anxiety, or stress and avoidance behaviour in athletes, which can affect well-being, interpersonal behaviour, and sporting performance.

The outbreak of the COVID-19 pandemic required the implementation of governmental restrictions, such as quarantine, to contain the spread of the virus. These restrictions may have caused additional fears and stress among athletes, since they were not able to train regularly and properly maintain their physical condition. In addition, competitive sport is a means of socialising, which has an impact on player training, the promotion of a balanced sporting context, and the intention to continue practising the sport. Therefore, the physical and psychological well-being of athletes depends mainly on the social environments in which the sport is practised; that is, their well-being is related to the significant agents in the environment, which social isolation due to the pandemic restrictions may have impaired.

This publication brings together the latest research on these psychological factors that influence sports performance, physical health, the mental and psychological well-being of athletes, and adherence to sport.

Manuel Gómez-López, Antonino Bianco, and Carlos Marques da Silva
Editors

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Article

Pain and Psychological Readiness to Return to Sport in Elite Volleyball Players: A Cross-Sectional Study

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Abstract: Pain is modulated by multiple factors. A relevant psychological process peculiar to athletes and which could be associated with pain is Psychological Readiness to Return to Sport (PRRS). The analysis of this association in competition context is particularly important. Objective: To determine the correlation between the PRRS and pain intensity in elite volleyball players during their participation in a continental sporting event. Methods: A cross-sectional study was conducted. Data from 107 male volleyball players (23.50 ± 4.08 years of age) participating in the South American Volleyball Championship were used. The athletes answered a self-report questionnaire on the day the championship began regarding their history of injuries in the previous six months. The athletes who declared injuries were asked about the current pain intensity using the Pain Numeric Rating Scale (NRS) and Psychological Readiness to Return to Sport using the Injury-Psychological Readiness to Return to Sport scale (I-PRRS). Results: 43.93% (n = 47) of the athletes (23.70 ± 3.54 years) reported an injury in the six months prior to the championship. They presented a median on the NRS of three (interquartile range (IQR), 2–5), and 54 (IQR, 46–58) on the I-PRRS. The Spearman's Rho correlation test showed an inversely and moderate correlation (r_s = −0.36; p = 0.011; CI: −0.64–−0.08) between pain intensity and PRRS. Conclusions: In male elite volleyball players who participate in a Continental Championship in South America, higher levels of PRRS was correlated to lower pain intensity.

Keywords: pain; psychological process; psychological readiness; volleyball; return to sport; athletic injuries

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1. Introduction

Volleyball is one of the most popular sports in the world. At the competitive level it is physically demanding, causing sport injuries at different points in the athletes' lives. In this sense, it has been demonstrated that volleyball-related injuries have an estimated incidence range from 1.7 to 10.7 injuries per 1000 playing hours, occurring more often during matches and among male players [1,2]. These injuries have physical and psychological repercussions for the athletes that can affect their participation in competitions and training. Many of the repercussions brought about by the injuries can present in the periods before a competition [3,4], possibly affecting the athlete's performance in the competition.

One of the effects of sport injuries is pain. The current International Association for the Study of Pain (IASP) defines pain as an "unpleasant sensory and emotional experience associated with or resembling that associated with, actual or potential tissue damage" [5]. This protection mechanism [6] is modulated strongly by sensory, social, emotional, and cognitive factors [7,8], making its perception vary between different individuals and populations. A relevant factor to understand this difference between athletes and non-athletes is the former's common coexistence with pain during training or competitions [9–13]. Thus, athletes may potentially perceive pain as a normal part of their preparation (i.e., no pain, no gain) and activity, and not necessarily as threatening information always related to an injury [14]. This may help explain that athletes who have suffered an injury return to sporting activity and even competition although they perceive pain [10]. However, the study of other psychological processes that could be associated with the perception of pain when returning to sport is still in the beginning stages. A relevant psychological process unique to athletes and which could be associated with pain is psychological readiness to return to sport (PRRS).

To date, various consensuses have shown the importance of PRRS [15–17]. This is de-fined as a psychosocial process which athletes may experience before, during or after their transition from rehabilitation to returning to competitive sport [18]. In the event of an injury, the athlete can respond with low psychological readiness, which can last throughout the rehabilitation process [19] and even once the athlete has returned to the sport [20]. Low PRRS is characterized, on the one hand, by reduced confidence, motivation, functional attention and unrealistic expectations—and on the other hand, by high levels of fear, anxiety or distrust in using the injured part [21]. In this sense, it must be emphasized that high levels of fear and anxiety have been related to greater pain intensity, both in healthy subjects and in subjects affected by pathologies or injuries [22]. Thus, given that fear and anxiety are important components of the PRRS, a low level of this could be associated with a pain perception of greater intensity.

In addition, elite athletes should be considered to participate in high-stress environment sports competitions. These can put the athlete in positive or negative psychological conditions, such as motivation or stress [23] which influences the PRRS, and therefore modifies their relation to pain. Thus, the PRRS takes on special relevance during competitions, since these are important milestones for elite athletes. In this vein, it has been reported that PRRS and pain affect performance during competitions [24]. However, the association between the two variables in the competitive period has not been explored.

Thus, the present study seeks to broaden knowledge of the correlation of psychological processes, particularly PRRS, and pain. Consequently, this study seeks to determine the correlation between PRRS and pain intensity in elite volleyball players during a competition. The first step is to assess this psychological process with respect to the perception of pain, contributing to how it is managed. This makes it possible to develop or strengthen strategies that seek a successful return to sport after having suffered an injury, highlighting in this process the importance of a holistic view.

2. Materials and Methods

The reporting of the paper follows the STROBE guidelines [25]. This is to ensure effective and clear communication of all the important aspects of this research.

2.1. Study Design

An observational, cross-sectional and analytical study was conducted on volleyball players on the national team. This study was approved by the Science Ethics Committee of the Valdivia Health Service.

The target population was male players participating in the XXXIII South American Volleyball Championship held in Temuco and Santiago in September 2019 in Chile. This study was approved and supported by the South American Confederation of Volleyball and the Volleyball Federation of Chile.

The aim and methodology of the study were presented to the coaches and delegates during the qualifying process of the teams in the two host cities. Next, a meeting was held with the athletes of the teams to inform them about the study and ask for their participation. If the athletes agreed to participate, they signed the informed consent and the evaluation instruments were applied. The evaluation instruments were applied by specially trained personnel.

All the players were invited to participate, i.e., the 110 athletes from the eight national teams of South America: Argentina (n = 14), Bolivia (n = 12), Brazil (n = 14), Chile (n = 14), Colombia (n = 14), Ecuador (n = 14), Perú (n = 14) and Venezuela (n = 14). The inclusion criteria were the following: be a registered athlete in the championship, have medical release to compete and have signed the informed consent. There were no exclusion criteria.

2.2. Procedure and Instruments

On the first day of the Championship, the athletes completed a hard copy self-report questionnaire with sociobiodemographic and sporting information such as age (years), body mass (kg), height (m), origin (country), playing position (libero, setter, outside spiker, spiker, and middle blocker), dominant hand (left/right/ambidextrous) and dominant leg (left/right/ambidextrous). The dominant hand was defined as the hand that is used for spiking or serving. The dominant foot was defined as the foot that is used to kick a ball. In this questionnaire, they also answered questions about the presence of injuries in the 6 months prior to the championship. For this, injury is defined as: "All musculo-skeletal injuries (traumatic and overuse) newly incurred during competition or training regardless of the consequences with respect to the athlete's absence from competition or training" [26]. If the athletes did not report previous injuries the questionnaire was ended and they did not need to complete another one. However, if they reported an injury, they had to answer questions about the injury such as: duration (less than one month, between one and three months, three and six months), anatomical area and form of presentation of the injury (suddenly while performing normal training or competition or gradual onset, over several consecutive training sessions). Finally, they were asked about the current intensity of the pain with respect to their previous injury using the Numerical Rating Scale (NRS) [27] and the PRRS for sport today, through the self-report questionnaire Injury-Psychological Readiness to Return to Sport Scale (I-PRRS) [28,29].

The I-PRRS, developed by Glazer, is a self-administered 6-item questionnaire, considered easy to use, reliable and valid, to evaluate the PRRS of athletes to return to practice and competition participation after a sport injury and to measure the athlete's confidence at a particular point in time [28]. The 6-items are: 1. My overall confidence to play is; 2. My confidence to play without pain is; 3. My confidence to give 100% effort is; 4. My confidence to not concentrate on the injury is; 5. My confidence in the injured body part to handle to demands of the situation is; and 6. My confidence in my skill level/ability is. Each of the items is answered on a scale of 100 points with an interval of one point. A score of 0 indicates that the athlete has no confidence and a score of 100 indicates that the athlete has complete confidence in the item asked about. To calculate the total score, the score of each of the six items was added and divided by 10. A consensus of a panel of experts has argued that this instrument is of great help to professionals in determining the level of psychological readiness of athletes to return to sport [15].

2.3. Statistical Analysis

The statistical analysis was performed with the Stata program v. 14. The continuous variables were reported according to measures of central tendency and dispersion. The categorical variables are presented in relative and absolute frequencies. The fulfillment of the assumption of normality of the continuous variables was evaluated using the Shapiro–Wilk test. Where the assumption of normality was not fulfilled ($p < 0.05$), the medians and interquartile range (IQR) were reported, and the Spearman's rho coefficient (r_s) was calculated to explore correlations between I-PRRS total (and each of its items) vs. pain intensity.

The magnitude of the correlation was considered weak for 0.1, moderate for 0.3 and strong for 0.5 [30]. The analysis considered a statistical significance of 0.05.

3. Results

Of the 110 athletes, 97.3% (n = 107) agreed to participate and complete the questionnaires. Athletes of all the nationalities, i.e., the eight national teams, participated (23.50 ± 4.08 years old, 192.43 ± 9.00 cm of height, 87.30 ± 10.06 kg of weight) (see Figure 1).

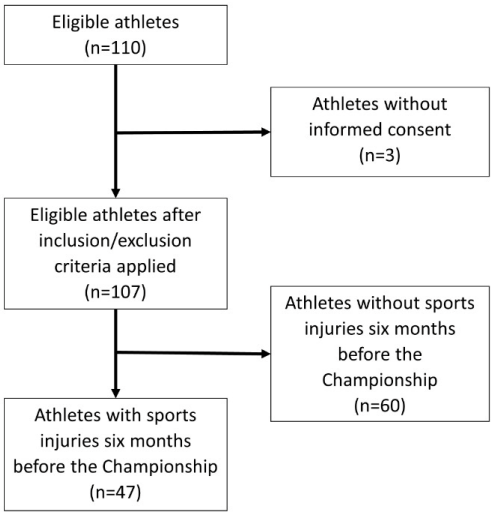

Figure 1. Flow diagram of athletes' inclusion.

Of all the participants, 47 players (43.93%) declared having had an injury in the six months prior to the Championship and having medical release to return to competition. All these players (n = 47) completed injury questionnaire, NRS and I-PPRS. Of these, 14 players (29.79%) suffered an injury in the month prior (NRS median 6, IQR 3–6), 20 (42.55%) between one and three months before (NRS median 3, IQR 2–3), and 13 (27.66%) between three and six months before the start of the Championship (NRS median 4, IQR 3–4). In the previously injured athletes, the NRS median was 3 (IQR, 2–5). The characteristics of the previously injured athletes are summarized in Table 1.

Table 1. Physical and sport characteristics of the athletes with previous injury.

	M ± SD	***n* (%)**
Age (years)	23.70 ± 3.54	
Height (cm)	192.11 ± 8.48	
Body mass (kg)	87.70 ± 9.83	
BMI	23.76 ± 2.18	
Game position		
Setter		7 (14.89)
Middle blocker		13 (27.66)
Outside spiker		9 (19.15)
Spiker		14 (29.79)
Libero		4 (8.51)
Dominant hand		
Right		44 (93.62)
Left		3 (6.38)
Dominant leg		
Right		39 (82.98)
Left		8 (17.02)

M = mean, SD = Standard deviation, n = number of participants, % = percentage, BMI = Body mass index.

With respect to the anatomical location of the injury, 26 athletes reported an injury in the lower limb (55.32%), 14 in the upper limb (29.79%), five in the lumbar or abdominal area (10.63%) and two in other areas (4.26%). In particular, the most affected zones were the knee (n = 18, 38.30%) followed by the shoulder (n = 7, 14.89%). With respect to the onset of the injury, 26 reported suddenly while performing normal training or competition (55.32%) and 21 gradual onset over several consecutive training sessions (44.68%).

The results of the Injury-Psychological Readiness to Return to Sport scale (I-PRRS) are described in Table 2.

Table 2. Injury-Psychological Readiness to Return to Sport Scale.

Item		Md (IQR)
1.	My overall confidence to play is	100 (90–100)
2.	My confidence to play without pain is	90 (60–100)
3.	My confidence to give 100% effort is	100 (99–100)
4.	My confidence to not concentrate on the injury is	90 (50–100)
5.	My confidence in the injured body part to handle to demands of the situation is	85 (60–100)
6.	My confidence in my skill level/ability is	100 (80–100)
I-PRRS total		54 (46–58)

Md = Median, IQR = Interquartile range.

Items 3 and 5, and the total score on the I-PRRS are correlated negatively and significantly with the intensity of the pain ($p < 0.05$). See details in Table 3.

Table 3. Correlation of the Injury-Psychological Readiness to Return to Sport Scale with Pain Numerical Rating Scales.

Items		r_s (95% CI)	p-Value
1.	My overall confidence to play is	−0.02 (−0.33–0.29)	0.898
2.	My confidence to play without pain is	−0.02 (−0.50–0.08)	0.162
3.	My confidence to give 100% effort is	−0.37 (−0.061–−0.12)	0.003 *
4.	My confidence to not concentrate on the injury is	−0.24 (−0.53–0.04)	0.093
5.	My confidence in the injured body part to handle to demands of the situation is	−0.54 (−0.78–−0.29)	<0.001 **
6.	My confidence in my skill level/ability is	0.01 (−0.31–0.34)	0.947
I-PRRS total		−0.36 (−0.64–−0.08)	0.011 *

r_s = Spearman's rho, 95% CI = 95% Confidence interval; * significant moderate correlation; ** significant strong correlation.

4. Discussion

The aim of this study was to determine the correlation between PRRS and pain intensity in elite male volleyball players during a competition. Our results showed that higher levels of PRRS was correlated to lower pain intensity in this group of athletes. This is relevant given that both factors may affect performance during a competition [24]. To the best of our knowledge, this is the first study to analyze this correlation in athletes during a competition.

We demonstrate an inverse and moderate correlation between pain intensity and PRRS. This result is in line with a recent study conducted by Sala-Barat et al. [31] on individuals

subjected to an anterior cruciate ligament reconstruction. They found that higher levels of psychological adaptation for the return to sports practice was related to lower pain intensity, with the magnitude of this correlation being moderate (i.e., $r_s = 0.4$) as in our study. In addition, it is worth noting that the scale used in the study by Sala-Barat et al. [31] (i.e., Spanish version of the anterior cruciate ligament-return to sport after injury) showed a strong correlation (i.e., r = 0.8) with the I-PRRS used in our study. The inverse correlation between pain intensity and the I-PRRS could be explained in three ways. First, during the injury period, particularly in the final recovery process, the athlete is commonly exposed to significant external pressure (i.e., trainers, team mates, family and mass media) as well as internal pressure (i.e., athletic identity, compensation, guilt) [32] which may lead to high levels of emotional anxiety and catastrophic thinking. These have been linked to the presence of greater pain intensity [33], which could be interpreted by the athlete as the presence of an injury despite having medical release, developing into a reduction in their PRRS. Consequently, elevated pain intensity could result in lower confidence while competing. Second, a high PRRS could be related to high self-efficacy for managing pain, which would involve a lower perception of pain [22]. Third, in the context of an important sporting competition there is high motivation to participate in the event, especially when they are very important. This carries with it a positive perception of returning to the sport [16], leading to high PRRS. Thus, the athlete would perceive the return to the sport as less threatening and may consequently have a lower perception of pain. However, these proposed reasons must be confirmed in future studies.

The correlation between pain intensity and the items on the scale highlights that high pain intensity is associated with low confidence in giving 100% of their effort. This could be related to competition being perceived as uncontrollable and unpredictable, forcing the athlete to give 100% effort at any time [34], and the presence of high pain intensity would prevent the athlete from performing certain movements, limiting the range of these movements and undermining the athlete's confidence in his ability.

The association between pain and confidence in the injured area may be explained by the nature of competitive sport. Volleyball demands a large repertoire of movements [35] which is why one movement of a joint in particular could be compensated by other joints. Thus, it is possible to return to competition despite not trusting the segment in particular. However, during the competition, the need to make a greater effort and achieve limited movements could generate a perception of threat when moving the injured segment and this increases the perception of pain. In the same vein, it must be noted that pain from an injury is perceived in a limited area of the body and if its perception is interpreted as an alarm, it can reduce confidence in the use of the segment. It must be emphasized that during the creation of the instrument, this item was assessed positively by experts since according to them, this item is the most relevant for PRRS [28].

A remarkable finding was the presence of pain one day before the competition in 41 (38.32%) athletes, despite having medical release. One condition that recurs in this population—as it is often one of the measures to achieve their sporting, economic and social objectives—is to compete in spite of the pain [9]. In our case, the athletes were facing a Continental Championship that takes place every two years and that allows them to face the best teams on the continent. In addition, this championship offered the opportunity to qualify for the Olympic Games, so it was expected that the athletes would be highly motivated. These results could indicate that the athletes, in spite of their motivation, could think they can participate in the game to a large extent without pain or with pain that allows them to perform their sport, but they do not trust they can give 100% effort and demand from the injured body part as a result of the pain, a highly likely situation during a competition of this type.

Several studies have reported that the physical variables do not account for the athlete's overall condition to return to the sport [36,37]. What is more, non-optimal psychological states [38] reduce the possibility of a successful return and increase the risk of a new injury [16]. This is especially relevant in the context of sporting competitions, where the

athlete must also cope with the physical demand imposed by the competition as well as the psychological demand. In this vein, it has been reported that PRRS and pain affect performance during competitions [24,39]. This underscores the importance of the periodic assessment and management of psychological processes, with special emphasis prior to competitions, by the health and coaching teams. In the same way, the correct management of the pain by the health team could improve the athlete's confidence, and promoting the PRRS could have a positive impact on the perception of pain. Thus, for instance, pharmacological treatment should only be considered one of the components of pain management and treatment [40]. However, a comprehensive approach should be considered, including physical aspects (i.e., individualized exercise plan, biomechanical factors, load progression, etc.) and psychological (i.e., sleep quality [41], coping strategies, self-efficacy, motor imagery, and confidence). It has been identified that confidence is one of the most important components of the PRRS [42], being an essential element in sporting success [15,17]. For example, developing the athlete's confidence in the injured part of the body, particularly with the use of target-setting strategies with respect the return to the sport (i.e., realistic goals, while also encouraging the player to accept they may still have limitations), could aid in a good transition to the return to competition [43]. This strategy is based on (1) evaluating the athlete globally (beliefs, objectives and attitudes), (2) setting a realistic and meaningful goal for the athlete, and (3) establishing clear specific objectives that allow the development of the general objective [44,45] (for more details, see Roberts & Kristiansen). This way, the evaluation of interventions that seek to improve PRRS, such as behavioral cognitive therapy or motivational interviews, could be relevant to improving the effectiveness of the treatment of painful syndromes or dysfunctions. Thus, future studies should include longitudinal designs and cognitive variables (i.e., catastrophism, self-efficacy) and emotional variables (i.e., distresses) and analyze their association with PRRS.

This study has some limitations. The cross-sectional nature of the study prevents conclusions from being drawn as to the causal directionality of our findings, making more studies necessary to clarify this association. Moreover, no calculation was made of the sample size due to the complexity of gaining access to these athletes during a Championship. In spite of this, we emphasize that 97.3% of the athletes registered agreed to participate in this study. The severity of the injury can also be a confounding factor when examining the return to the sport. The severity of the injury or pain treatments can also be a confounding factor when examining the return to the sport. Regarding the first, the athletes with more serious injuries can show more prolonged negative psychological responses of greater magnitude [16]. This information could not be compiled given the limited access time to the athletes. The sample was comprised of a homogenous group of athletes—elite Latin American male volleyball players—which means they have particular characteristics. Therefore, extrapolation of these results to other populations must be done with caution. However, considering the lack of studies in the field, we believe this study could serve as a basis for future studies. Furthermore, these future studies should include larger sample sizes along with probability sample designs, which would make it possible to generalize the findings and consider variables that could modify the association between pain and psychological readiness, such as severity of injury, type of treatment, etc.

5. Conclusions

In male elite volleyball players who participate in a Continental Championship in South America, there is an inverse and moderate correlation between the PRRS and pain intensity, that is, higher levels of PRRS was correlated to lower pain intensity. Our results show an aspect to be taken into account in the management of athletes with pain who return to competition. These findings must be considered by the health and coaching teams since both variables are potentially modifiable and may impact on the athletes' performance during a competition. Furthermore, we believe that new studies are needed to understand the effect of the intervention in PRRS on pain, and vice versa, in elite athletes,

as well as studies that make it possible to understand the role of PRRS in managing pain in elite athletes.

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Relationships between Perfectionism, Extra Training and Academic Performance in Chinese Collegiate Athletes: Mediating Role of Achievement Motivation

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Abstract: There are limited studies examining the impacts of perfectionism and achievement motivation on collegiate athletes' extra training and academic achievement in a Chinese context. This study aimed to examine the association of perfectionism (five facets) with extra training and academic performance among Chinese collegiate athletes and identify the mediating role of achievement motivation (two attributes) in the relationship between perfectionism and extra training and academic performance. With a prospective study design, 243 eligible participants completed two-wave surveys from September to December 2021. Measures included demographics, perfectionism (concern over mistake, CM; doubts about action, DA; personal standard, PS; organization; parental expectation, PE), achievement motivation (motive for success, MS; motive for avoiding failure, MF), extra-training (minutes/week), and academic performance (GPA). Results showed that CM, DA, PS, and MS were associated with extra training among Chinese collegiate athletes, while the associations of DA and PS with extra training were mediated by MS. In addition, DA, PS, organization, and MS were associated with participants' GPA, while MS was a salient mediator for the contributions of DA and PS on participants GPA. Research findings give new insights to the psychological mechanisms of perfectionism and achievement motivation on collegiate athletes' extra training and academic performance, contributing to future studies in relevant domains.

Keywords: personality; achievement motivation; perfectionism; collegiate athlete; basketball players; mediation; extra training; education

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1. Introduction

Personality, a core psychological characteristic of an individual, reflects the consistent and stable patterns of an individual's thoughts, feelings, and behaviors [1,2]. Different personalities show different behavioral characteristics in the pursuit of personal goals [2]. Perfectionism, a personality trait, is characterized by an individual's concerns with striving for flawlessness and perfection and is accompanied by critical self-evaluations and concerns regarding others' evaluations [3,4]. People who pursue high perfection in their own performance, set high requirements/standards for themselves, and emphasize that everything they undertake should be organized, are known as "perfectionists" [3,4]. Traditionally, perfectionism was regarded as a single-dimensional personality disposition which is a sign of psychological maladjustment and disorders as individuals seeking psychological support for depression and anxiety often show elevated levels of perfectionism [5,6]. However, with the development of theories and empirical evidence in the last 20 years, a new consensus has emerged that conceptualized perfectionism as a multidimensional and multifaceted trait, which includes two higher-order dimensions: *perfectionistic concerns* and *perfectionistic strivings* [5–8]. Perfectionistic concerns capture several facets of perfectionism associated

with concern over mistakes, feelings of discrepancy between one's expectations and performance, and negative reactions to imperfection (doubts about action), while perfectionistic strivings capture those aspects associated with self-oriented striving for perfection and setting exceedingly high standards of performance [5,6]. Perfectionism has been demonstrated with a series of social-cognitive and behavioral outcomes (e.g., motivation, sport, education) [6,7]. Research on the perfectionism has also extended from emphasizing negative characteristics and only behavioral aspects to underlining positive aspects and in-depth exploration of multiple structural characteristics [5]. Most existing studies focused on the two higher-order dimensions of perfectionism, which found that perfectionistic concerns show consistent positive relationships with maladaptive outcomes (e.g., burnout), while perfectionistic strivings show positive relationships with both maladaptive and adaptive outcomes (e.g., academic engagement and good performance) [7–10]. However, research on the specific aspects within each dimension (e.g., concern over mistake and doubts about action for the perfectionistic concerns dimension, and personal standard, organization, and parental expectation for the perfectionistic strivings dimension) is limited. In this regard, differentiating these specific facets of perfectionism is crucial as they show distinct patterns of relationships with various outcomes.

In the sports domain, perfectionism is considered a crucial personality trait, which is regarded as a common characteristic for world Olympic champions [11]. Perfectionism is also closely related to competition anxiety, achievement motivation, psychological fatigue, sports performance, and other sports-related activities [12–15]. Hardy et al. stated that athletes who excessively pursue perfection tend to set higher personal standard for themselves and show better organization, which can obtain satisfaction from their own behavior and produce lower pressure [16]. By contrast, for athletes who pursue perfection, higher expectations from the outside may result in psychological pressure, which has a negative influence on athletes' performance [17,18]. In addition, athletes with perfectionism not only tend to complete the training tasks assigned by the coach, but also conduct extra training to improve themselves, whereby they improve their performance in the competition [17]. Extra training can help automate athletes' skills, reducing the negative impact of psychological stress on sport performance [17]. According to the literature, studies related to extra training mainly focus on the medical field to improve patients' physical functions [19,20], while research in the sports domain is still limited. Two studies indicated a positive association of perfectionistic strivings with engagement in sport-specific activities (including extra training) in team sport athletes in Western countries, but these studies did not particularly focus on extra training, and the relationship between perfectionistic concerns and behavioral outcomes is still unclear [8,21]. There is also a scarcity of evidence examining this issue in a Chinese context.

Perfectionism can not only affect individuals' psychological fatigue and sports performance, but also promote the improvement of academic performance. Studies showed that students with perfectionism generally present outstanding qualifications and excellent performance [22,23]. They further pointed out that the proportion of the number of students becomes more and more obvious with the increase of age and grade. Previous study reported that students with perfectionism emphasize personal standard and organization, showing higher motivation for success [24]. Therefore, they tend to devote more efforts to achieve their ideals and goals. Previous studies regarding perfectionism and academic performance mainly targeted middle school students or collegiate students, while studies with collegiate athletes are still limited.

In addition, the mediation mechanism of the impact of perfectionism on extra training and academic performance has raised increasing concerns recently, where the achievement motivation has been suggested as a potential mediator [25]. Generally, the motivation is to inspire and maintain the organism's action, and action leads to a goal psychological tendency or internal drive [25,26], which is an important source of motivation for its success. Achievement motivation refers to the internal motivation for people to succeed in the process of completing tasks, as well as an internal driving force that people are

willing to do what they believe is important and valuable and strive for perfection [27]. Many studies showed that achievement motivation is mainly manifested in the *motive for success* and *motive for avoiding failure* [28,29]. In addition, it is an impulse of competition between internal and external standards of excellence, with differences mainly reflected in individual social orientation and ego orientation [30]. Some studies indicated that motive for success is positively associated with performance while motive for avoiding failure is negatively related to performance [31–33]. However, no relationship between achievement motivation and academic achievement was also found in other studies [33]. Given the mixed findings, further examination on this relationship is needed, especially in the special samples of collegiate athletes as they need not only spend time on sports training, but also on their studies. In addition, achievement motivation has proven to be a mediator between perfectionism and other outcomes (e.g., subjective well-being) [34], while to the best of our knowledge, there are limited studies examining whether the achievement motivation is the intermediary variable between perfectionism and extra training and academic performance.

Given the above, the current study aimed to explore the association of five facets of perfectionism with extra training and academic performance among Chinese collegiate athletes, and to identify whether the two attributes of achievement motivation play a mediating role in the association of perfectionism with extra training and academic performance. From a theoretical perspective, both perfectionistic concerns and perfectionistic strivings could be associated with extra training and academic achievement [6,7], particularly when individuals have overly critical evaluations and concerns about making mistakes and doubt their action. These perfectionistic concerns are associated with worry, rumination, and other maladaptive cognitions that may stifle productive behavior, where individuals with high perfectionistic concerns may experience overwhelming feelings of pressure [7]. Consequently, they may be more concerned about avoiding mistakes and spend less time on relevant activities and instead procrastinate as a method to avoid facing potential failure. By contrast, individuals with high perfectionistic strivings often set exceptionally high standards that will direct, motivate, and regulate behaviors that are beneficial for a better performance. Individuals may spend more time on relevant activities to achieve success.

We, therefore, hypothesized that:

(a) the aspects of perfectionistic concerns (i.e., concern over mistake and doubts about action) would show direct and negative association with extra training (hypothesis 1a);
(b) the aspects of perfectionistic strivings (i.e., personal standard, organization and parental expectation) would show direct and positive association with extra training (hypothesis 1b);
(c) two attributes of achievement motivation (i.e., motive for success and motive for avoiding failure) would mediate the relationship between perfectionistic concerns aspects and extra training (i.e., the direct effect would be attenuated; hypothesis 1c)
(d) the aspects of perfectionistic concerns (i.e., concern over mistake and doubts about action) would show direct and negative association with academic performance (GPA) (hypothesis 2a);
(e) the aspects of perfectionistic strivings (i.e., personal standard, organization and parental expectation) would show direct and positive association with academic performance (GPA) (hypothesis 2b);
(f) two attributes of achievement motivation (i.e., motive for success and motive for avoiding failure) would mediate the relationship between perfectionistic concerns aspects and academic performance (GPA) (i.e., the direct effect would be attenuated; hypothesis 2c). The research framework is shown in Figure 1.

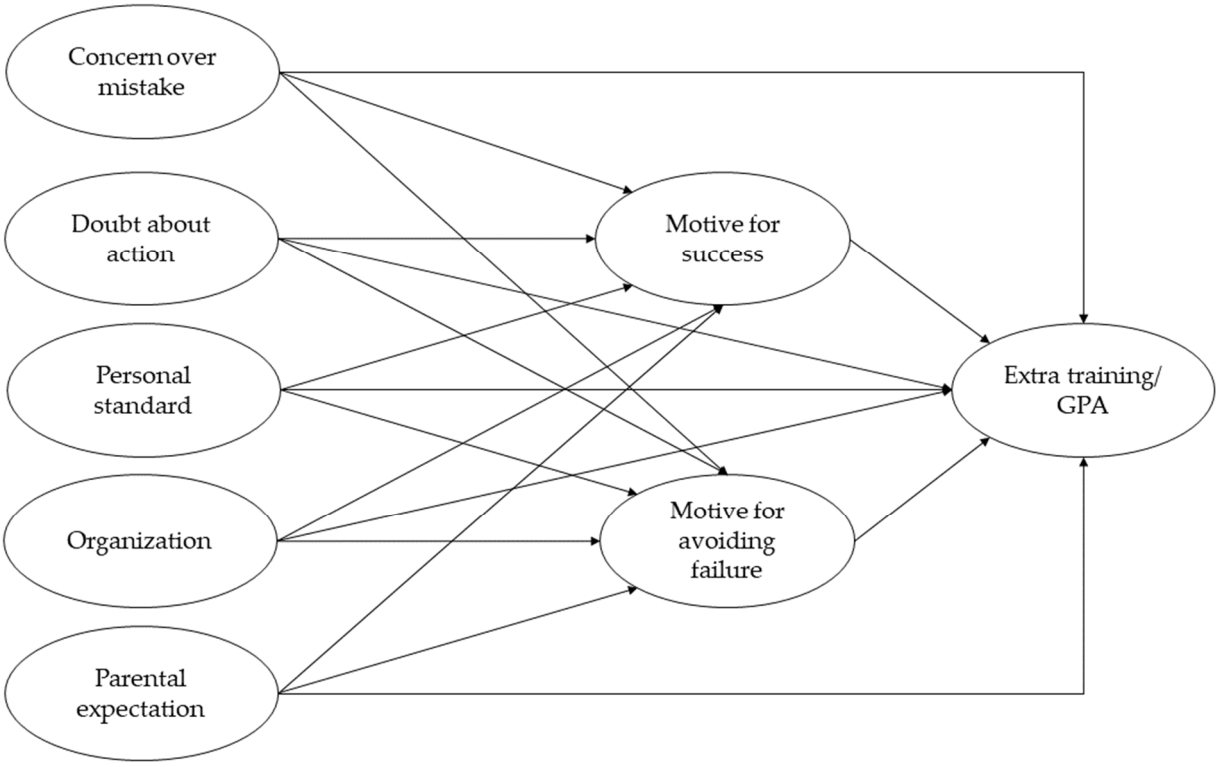

Figure 1. Hypothesized model of the mediating role of achievement motivation in the association of perfectionism with extra training and academic performance (GPA).

2. Materials and Methods

2.1. Study Design, Participants, and Procedure

The study used a prospective design with two-wave data collection. We contacted 260 collegiate basketball players from colleges and universities in the cities of Beijing, Wuhan, Shanxi, and Fujian, using a convenience sampling method. All eligible participants met certain criteria, including (1) aged $\geq$ 18 years; (2) being a member of representative sport team of university or having more than 3 years basketball training background; and (3) sufficient language skills in Chinese. The paper questionnaires were distributed to the participants before and after the regular training sessions with the assistance of coaches. A total of 255 eligible participants completed the first-wave data collection during the last week of September 2021. Finally, 243 (203 boys, 40 girls, age: 20.56 $\pm$ 1.51 years) participants completed the second-wave data collection at the 3-month follow-up in December 2021. Based on the common rule of thumb for estimating the sample size for a structural equation modeling (SEM) (i.e., the sample size is usually 10 times the number of variables) [35,36], the sample size of 243 was sufficient for this study. All participants were informed about the study purpose and signed the written informed consent form before the data collection. Participants were asked to complete the paper questionnaires anonymously and independently. The data collection was conducted at the training venues and each survey lasted 15–20 min.

2.2. Measures

2.2.1. First-Wave Data Collection

Demographics and perfectionism were measured in the first-wave data collection.

Demographic variables included age, gender, grade (freshman/sophomore/junior/senior), major (arts-related/sciences-related), and training duration.

For the Perfectionism Scale, the Chinese Version of Frost Multidimensional Perfectionism Scale (MPS-F) by Zi Fei (2006) [37] was adopted. In this study, five dimensions of the scale were applied: Concern over mistake (9 items, for example, "if I made a mistake, I will

upset"), personal standard (7 items, such as "if I don't set the highest standards for myself, I could be a mediocre person"), doubt about action (4 items, such as "even if I do one thing very carefully, also often think of things is not good enough"), organization (6 items, e.g., "Organization/organization is very important to me"), and parental expectation (5 items, e.g., "My parents set high standards for me"). The dimensions of personal standard and organization constitute well-adapted perfectionism, while the other three dimensions constitute maladaptive perfectionism. A total of 31 items were included in the scale, and a 5-point Likert score was used to mark "very inconsistent" to "very consistent" as 1–5 points. The scale is all positive scoring questions. The higher the total score and the higher the score of each dimension, the stronger the perfectionism tendency. Both subscales demonstrated acceptable internal reliability with Cronbach's α = 0.863, Cronbach's α = 0.702, Cronbach's α = 0.739, Cronbach's α = 0.725, and Cronbach's α = 0.782, respectively.

2.2.2. Second-Wave Data Collection

The achievement motivation, extra training time, and academic performance were measured at the second-wave data collection.

For Achievement Motivation Scale, Ye Renmin and Hagtvet's version was used [38]. This scale consists of 30 items, which are divided into 2 subscales: *motive for success dimension* and *motive for avoiding failure*. The responses were given on a 4-point Likert scale, ranging from "4 = completely right" to "1 = completely wrong". A higher total score of the scale (i.e., the score of the *motivation for success* subscale minus the score of the *motivation for avoiding failure* subscale) indicates a stronger achievement motivation. Both subscales demonstrated acceptable internal reliability with Cronbach's α = 0.884 and Cronbach's α = 0.873, respectively.

The extra training time (hours/week) was self-reported by the participants and the academic performance was measured by the semester grade point average (GPA). The semester GPA was collected directly from the university records, which was calculated using the credit-weighted sum of the grades for all courses divided by the total credits. The GPA was coded on a continuous scale ranging from "A = 4" to "F = 0 (failed)".

2.3. Statistical Analysis

Data screening and primary analyses were conducted using the IBM SPSS 27.0 (Armonk, NY, USA). Invalid and abnormal data were cleaned prior to the data analyses. Data distribution was detected by the Q-Q plot and S-K test. Mean values, standard deviation, and percentage were used to present the descriptive information of study samples. Zero-order correlation between target variables was examined using the Pearson/Spearman correlation coefficients. Mplus 8.0 (Los Angeles, CA, USA) was employed for the mediation analyses. The model fit was evaluated using several goodness-of-fit indices, including Chi-square (χ^2), Chi-squared/deviation freedom (χ^2/df), comparative fit index (CFI), Tucker–Lewis fit index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). The general criteria for an acceptable model fit were <5 for χ^2/df, >0.90 for CFI and TLI, and <0.08 for RMSEA and SRMR [39,40]. For all direct and indirect effects in the path analysis, standardized coefficients (β) with 95% confidence intervals (CI) were calculated using maximum likelihood estimation with a bias-corrected bootstrapped approach (5000 resamples). All the demographics were included as covariates in the model analyses. All significance levels were set as $p < 0.05$ (two-tailed). The effect size of Cohen's f^2 for the model prediction was calculated by using the equation "$f^2 = R^2/(1 - R^2)$", with 0.02, 0.15, and 0.35 indicating a small, moderate, and large effect, respectively [41,42].

3. Results

3.1. Sample Characteristics and Primary Analysis

A total of 243 (83.5% males) collegiate basketball players were included in the analyses, with an average age of 20.56 years (SD = 1.51; 18–27 years). Most of the participants (65.8%)

majored in science-related subjects. The percentage of freshman, sophomore, junior, and senior was 25.1%, 20.9%, 23.0%, and 21.0%, respectively. The average training duration of participants was 3.91 years (SD = 1.08; 1–5 years).

For the primary analysis, only a few of the scale items departed from the normality distribution and the absolute values of skewness and kurtosis were 1.12–1.47 (>1). The robust maximum likelihood estimation approach was therefore used in the CFA whereby the standard errors and tests of model fit were robust with respect to the observed variables with non-normal distribution [39,43]. As presented in Table 1, the measurement scales showed acceptable internal consistency reliability, with Cronbach's α coefficients ranging from 0.70 to 0.88. The model-fit indices from seven preliminary CFAs of these scales indicated an acceptable-to-good fit to the data ($\chi^2/df \leq 2.39$, CFI ≥ 0.94, TLI ≥ 0.92, RMSEA ≤ 0.08, and SRMR ≤ 0.05), with all item-factor loadings being acceptable ($\geq$0.38). Finally, the inter-factor correlations did not encompass unity, indicating the distinction of concept among these factors.

Table 1. Model fit of the measurement model (n = 243).

Models	α	χ^2	p	df	χ^2/df	CFI	TLI	RMSEA	90% CI of RMSEA	SRMR	Factor Loading
CM	0.863	22.555	0.02	11	2.050	0.980	0.963	0.066	0.025–0.104	0.031	0.379–0.831
PS	0.702	15.192	0.17	11	1.381	0.977	0.955	0.040	0.000–0.083	0.037	0.386–0.721
DA	0.739	Saturated measurement model									0.598–0.805
OR	0.725	13.505	0.14	9	1.501	0.969	0.948	0.045	0.000–0.092	0.038	0.425–0.740
PE	0.782	7.851	0.09	4	1.963	0.986	0.966	0.063	0.000–0.128	0.024	0.522–0.757
MS	0.884	76.497	<0.001	32	2.391	0.942	0.919	0.076	0.054–0.098	0.056	0.460–0.855
MF	0.873	65.637	<0.001	34	1.931	0.948	0.932	0.062	0.039–0.084	0.049	0.537–0.823

χ^2 = Chi-square; df = degrees of freedom; CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; CM, PS, DA, OR, PE denoted concern over mistake, personal standard, doubts about action, organization, and parental expectations, respectively; MS and MF denoted motive for success and motive for avoiding failure, respectively.

Table 2 shows the Pearson correlation coefficients of study variables. Small-to-moderate correlations (r = 0.15–0.49) were found among these variables, indicating that there was no serious multicollinearity in the hypothesized mediation model.

3.2. Main Analysis

Both mediation models showed a satisfactory model-fit, with χ^2/df = 1.39, CFI = 0.99, TLI = 0.95, RMSEA = 0.04, and SRMR = 0.03 for extra training, and χ^2/df = 1.39, CFI = 0.99, TLI = 0.96, RMSEA = 0.04, and SRMR = 0.03 for academic performance. The overall model explained 22% and 37% of the variance in extra training (Cohen's f^2 = 0.28) and academic performance (Cohen's f^2 = 0.59), respectively.

As shown in Figure 2, for the direct effects of perfectionistic concerns aspects on extra training, results revealed a significant negative association of concern over mistake ($\beta = -0.13$, SE = 0.06, p = 0.021), and a positive association of doubts about action (β = 0.18, SE = 0.06, p = 0.005) with extra training. For the aspects of perfectionistic strivings, only personal standard (β = 0.13, SE = 0.06, p = 0.045) showed a significant correlation with extra training, while neither organization nor parental expectation was significantly associated with extra training (both $p > 0.10$). For two achievement motivation attributes, a significant association of extra training was only found on motive for success (β = 0.34, SE = 0.06, $p < 0.001$).

Table 2. Means, standard deviations, ranges, and inter-correlations of the study variables (n = 243).

Variables	1	2	3	4	5	6	7	8	9
1. CM	1								
2. PS	0.09	1							
3. DA	0.29 **	0.29 **	1						
4. OR	0.03	0.39 **	0.09	1					
5. PE	0.24 **	0.41 **	0.32 **	0.30 **	1				
6. MS	0.16 **	0.39 **	0.31 **	0.14 *	0.30 **	1			
7. MF	0.18 **	0.11	0.31 **	−0.08	0.19 **	0.31 **	1		
8. ET	−0.03	0.31 **	0.26 **	0.15 *	0.18 **	0.40 **	0.08	1	
9. AP	0.18 *	0.44 **	0.33 **	0.32 **	0.28 **	0.49 **	0.22 **	0.22 *	1
Mean (SD)	3.01 (0.93)	3.51 (0.56)	3.12 (0.80)	3.98 (0.54)	3.11 (0.80)	2.51 (0.57)	2.25 (0.58)	3.26 (2.44)	3.29 (0.47)
Range	1–5	2.14–5	1–5	1.83–5	1–5	1–4	1–4	0–8	2–4

CM = concern over mistake; PS = personal standard; DA = doubts about action; OR = organization; PE = parental expectation; MS = motive for success; MF = motive for avoiding failure; ET = extra training; AP = academic performance; SD = standard deviation; * $p < 0.05$; ** $p < 0.01$.

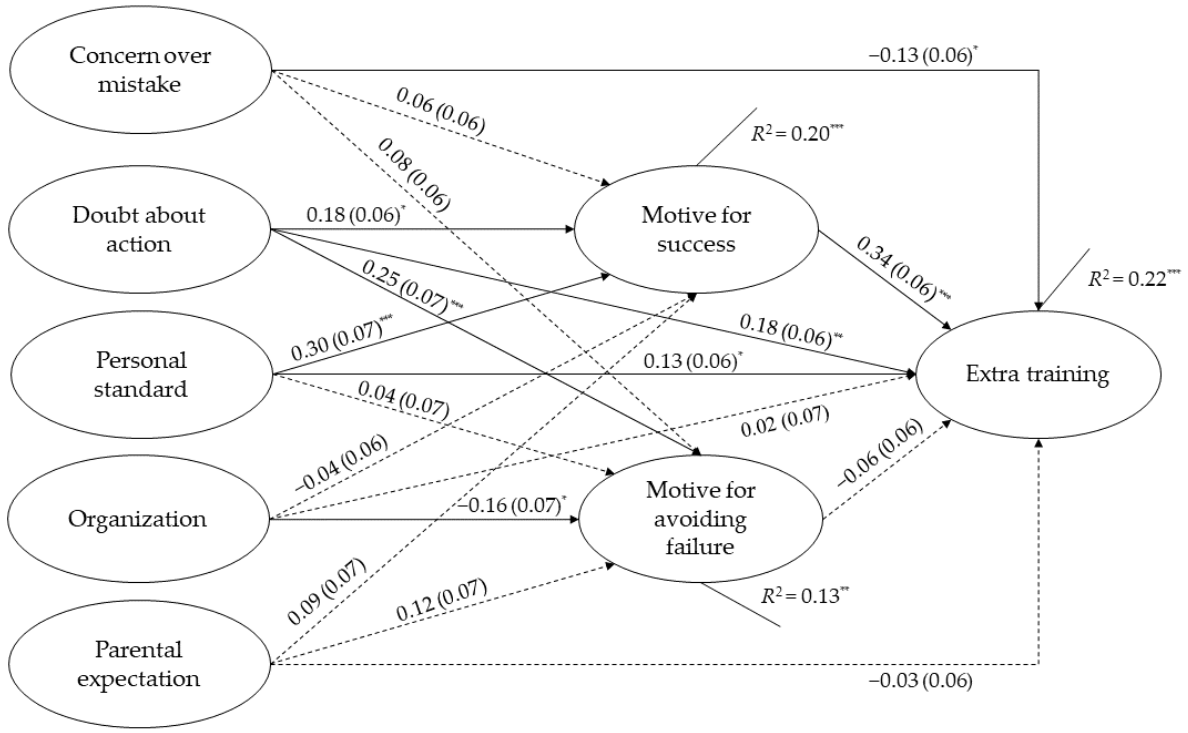

Figure 2. Final structural model with standardized path coefficients and standard errors for perfectionism, achievement motivation, and extra training (n = 243). All the demographics were included as covariates. Significant path is indicated by solid line and non-significant path is indicated by dotted line. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

For the indirect effects, as shown in Table 3, two significant mediating paths were identified. Particularly, motive for success significantly mediated the association between personal standard and extra training (β = 0.10, p = 0.002), and between doubts about action and extra training (β = 0.06, p = 0.027).

Table 3. Standardized parameter estimates for the direct, indirect, and total effects in the mediation models of extra training and academic performance in study samples (n = 243).

Effects	Extra Training (ET)				Academic Performance (GPA)			
	β	p	95%CI		β	p	95%CI	
			LB	UB			LB	UB
Direct effects								
CM→ET	−0.13	0.021	−0.22	−0.03				
PS→ET	0.13	0.045	0.02	0.24				
DA→ET	0.18	0.005	0.07	0.28				
OR→ET	0.02	0.71	−0.09	0.13				
PE→ET	−0.03	0.63	−0.13	0.07				
MS→ET	0.34	<0.001	0.23	0.43				
MF→ET	−0.06	0.26	−0.15	0.03				
CM→GPA					0.07	0.15	−0.01	0.14
PS→GPA					0.20	0.001	0.10	0.29
DA→GPA					0.12	0.037	0.02	0.21
OR→GPA					0.20	<0.001	0.11	0.29
PE→GPA					−0.01	0.82	−0.09	0.07
MS→GPA					0.33	<0.001	0.23	0.43
MF→GPA					0.06	0.30	−0.03	0.15
Indirect effects								
CM→MS→ET	0.02	0.38	−0.02	0.05				
PS→MS→ET	0.10	0.002	0.06	0.17				
DA→MS→ET	0.06	0.027	0.02	0.11				
OR→MS→ET	−0.01	0.58	−0.05	0.02				
PE→MS→ET	0.03	0.23	−0.01	0.08				
CM→MF→ET	−0.01	0.43	−0.02	0.001				
PS→MF→ET	−0.003	0.69	−0.02	0.003				
DA→MF→ET	−0.02	0.30	−0.05	0.004				
OR→MF→ET	0.01	0.35	−0.002	0.03				
PE→MF→ET	−0.01	0.38	−0.03	0.001				
CM→MS→GPA					0.02	0.37	−0.01	0.05
PS→MS→GPA					0.10	0.003	0.05	0.16
DA→MS→GPA					0.06	0.037	0.02	0.11
OR→MS→GPA					−0.01	0.58	−0.05	0.02
PE→MS→GPA					0.03	0.21	−0.01	0.08
CM→MF→GPA					0.01	0.49	−0.001	0.02
PS→MF→GPA					0.002	0.74	−0.004	0.02
DA→MF→GPA					0.02	0.34	−0.01	0.05
OR→MF→GPA					−0.01	0.42	−0.03	0.003
PE→MF→GPA					0.01	0.41	−0.002	0.03

Table 3. *Cont.*

Effects	Extra Training (ET)				Academic Performance (GPA)			
	β	p	95%CI		β	p	95%CI	
			LB	UB			LB	UB
Total effects								
CM→ET	−0.12	0.046	−0.22	−0.02				
PS→ET	0.23	<0.001	0.12	0.33				
DA→ET	0.22	0.001	0.11	0.33				
OR→ET	0.02	0.75	−0.09	0.13				
PE→ET	−0.004	0.94	−0.10	0.10				
CM→GPA					0.09	0.08	0.01	0.17
PS→GPA					0.30	<0.001	0.19	0.39
DA→GPA					0.19	0.001	0.10	0.28
OR→GPA					0.18	0.003	0.08	0.28
PE→GPA					0.03	0.64	−0.07	0.13

β = Standardized parameter estimate; 95% CI = 95% confidence interval of standardized parameter estimate; LB = lower bound of 95% CI; UB = upper bound of 95% CI; CM = concern over mistake; PS = personal standard; DA = doubts about action; OR = organization; PE = parental expectation; MS = motive for success; MF = motive for avoiding failure; →: indicating the former variable predicts the latter one. All demographics were included as covariates.

For academic performance (GPA), 4 of 7 direct paths were found to be significant (Figure 3). Specifically, one aspect of perfectionistic concerns and two aspects of perfectionistic strivings showed significant associations with academic performance, including doubts about action (β = 0.12, SE = 0.06, p = 0.037), personal standard (β = 0.20, SE = 0.06, p = 0.001), and organization (β = 0.20, SE = 0.06, p < 0.001). For achievement motivation attributes, only motive for success was found to be significantly associated with participants' academic performance (β = 0.33, SE = 0.06, p < 0.001).

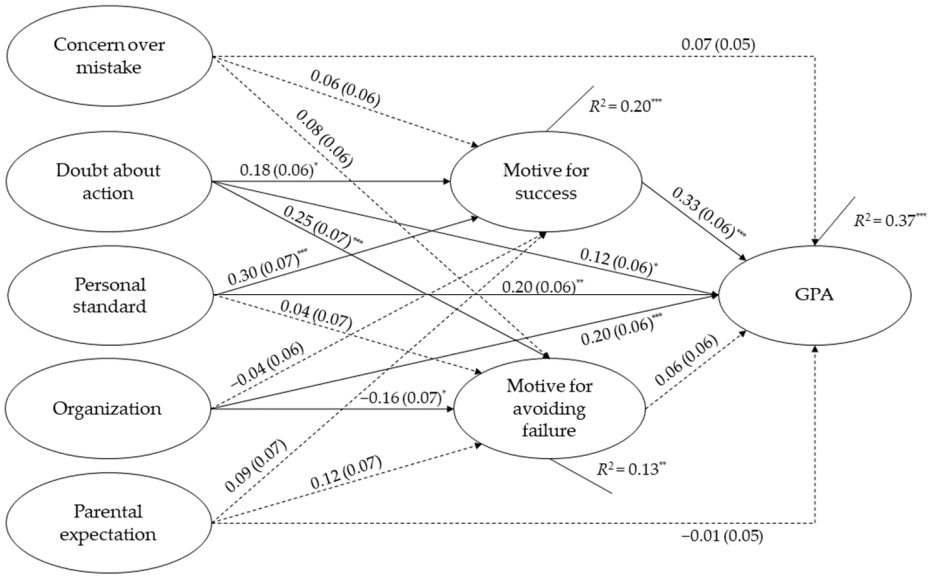

Figure 3. Final structural model with standardized path coefficients and standard errors for perfectionism, achievement motivation, and academic performance (GPA) (n = 243). All the demographics were included as covariates. Significant path is indicated by solid line and non-significant path is indicated by dotted line. * p < 0.05, ** p < 0.01, *** p < 0.001.

For the indirect effects, motive for success was identified as a significant mediator for the associations of personal standard (β = 0.10, p =0.003) and doubts about action (β = 0.06, p = 0.037) with academic performance (see Table 3).

4. Discussion

This study explored the psychological mechanisms affecting extra training and academic performance of Chinese collegiate athletes from the perspectives of perfectionism and achievement motivation. In this study, we identified the direct effect of certain perfectionism aspects on extra training and academic performance in collegiate athletes. In addition, our findings also provided evidence for the mediating effects of the achievement motivation (i.e., motive for success) in the association of perfectionism with extra training and academic performance. Overall, the proposed mediation model showed a good fit, and study hypotheses were partially supported.

For extra training, both aspects of perfectionistic concerns (i.e., concern over mistake and doubts about action) were significantly associated with and accounted for a significant portion of the variance of extra training. Interestingly, these two associations showed different directions. For concern over mistake, it showed a negative correlation with extra training. Collegiate athletes with lower concern over mistake have a stronger tendency to extra training than those with higher. This result is consistent with a previous study reporting that athletes reducing their negative reactions to their own wrong movements improve their confidence and spend more time on training [44]. For doubts about action, it showed a positive association with extra training, which is contrary to our previous hypothesized association direction. As there is a lack of relevant evidence on examining the relationship between perfectionism and extra training, it is difficult to make a comparison. A previous study showed that athletes with higher doubts about their ability to complete tasks need more extra training to achieve their goals [45]. This may, to some extent, provide a potential explanation. However, more research on this point is needed. For the aspects of perfectionistic strivings, only personal standard showed a significant positive association with extra training. Collegiate students who had higher personal standard spent more time on extra training. This is consistent with previous suggestions and evidence [8,21]. It is noteworthy that a recent meta-analysis study concluded that perfectionistic strivings have a small-to-medium effect on a better performance in sport, while perfectionistic concerns were found to not be associated with performance [46]. Taken together with our findings, it suggests that different aspects of perfectionism may differ in the relationship with extra training among collegiate athletes and these relationships are complex and ambiguous. More research on examining these relationships is warranted.

In addition, personal standard and doubts about action have a significant effect on motive for success. Motive for success partially mediated the relationship between personal standard, doubts about action, and extra training. The result showed that there is a positive correlation between personal standard and achievement motivation, which explains a large part of the variance of achievement motivation. Previous studies reported that the pursuit of perfection is positively correlated with motive for success, which is related to the adaptation mode of achievement motivation [31,47]. Furthermore, a study mentioned that personal standard highly predicts the level of individual achievement motivation [48], implying that collegiate athletes with higher personal standard are likely to spend more time on training to pursue success. Moreover, different from previous studies, the result of current study showed a positive correlation between doubt about action and motive for success, which explained a small part of the variance of achievement motivation. A potential explanation may be that self-oriented perfectionists' motive for success can influence their achievement goals and behaviors [49,50]. When athletes have doubts about their ability to complete tasks, which enable them to set a higher goal, resulting in extra training to achieve their goal.

For academic performance, we found that one aspect of perfectionistic concerns and two aspects of perfectionistic strivings were significantly associated with academic perfor-

mance of collegiate athletes. Specifically, collegiate athletes with higher personal standard and organization levels showed better academic performance than those with lower. Previous studies have proven that the high standard dimension of positive perfectionism is positively correlated with students' grades, and students with higher perfectionism beliefs tend to have good learning habits and perseverance, and work in a more organized way, which results in better academic performance [51]. This finding supports Hamachek's theory that students with higher standards of positive perfectionism are more likely to achieve good grades [52]. Different from previous studies, this study found that collegiate athletes with higher level of doubt about action had better academic performance. A possible explanation is that when collegiate athletes doubt themselves to complete certain task, they may show an indomitable spirit to work hard in order to achieve their goal [53], resulting in better academic results. Furthermore, the result reported that the motivation to pursue success is positively correlated with academic performance and has a large effect size. According to Atkinson's theory of achievement motivation, achievement motivation involves the emotional conflict between the expectation of success and the fear of failure [54], and the difference of achievement motivation is an important factor affecting the academic performance of students [55], showing that students with higher achievement motivation have better academic performance than those with lower [56,57]. Additionally, collegiate students with higher academic performance have higher motivation to pursue success [58,59], which is consistent with the results of current study.

In addition, the current research showed that there was a significant positive correlation between personal standard, doubt about action, and motive for success. Motive for success significantly mediated the relationship between personal standard and academic performance, as well as the relationship between doubt about action and academic performance. It is easy to explain that collegiate athletes who have higher standards tend to have a higher level of motivation to pursue success, resulting in achieve better academic results. On the other hand, collegiate basketball players who doubt themselves may spend more time on their study or training to achieve their goal [59].

From the perspective of psychology, extra training and academic performance are very important for collegiate athletes. However, there is limited research focusing on the relationship of specific aspects of perfectionism with extra training, academic performance, and the intermediary role of the achievement motivation in this relationship. This study can theoretically improve the basic research on perfectionism and achievement motivation. In terms of practical contribution, we suggest that coaches and teachers need to focus more on developing collegiate athletes' success experience, improving their motivation for success, and designing appropriate lectures and training to improve their interest in learning, which may improve collegiate athletes' personalities and motivate their success motivation. As a result, it may improve collegiate athletes' sports performance through extra training, and devoting more time to pursue better academic performance.

Several limitations should be noted. Firstly, as the sampling was not based on a random approach, the participants may vary in relation to the actual patterns of the general collegiate athletes (e.g., in other individual or team sports, in female samples and in those who are majored in arts-related subjects). Therefore, the representativeness and generalizability of our findings should be further examined in future studies. Moreover, the extra-training was measured by self-reported items which might result in the recall bias and social desirability effects. Finally, although prospective design allowed for conclusion about the predictive validity of the mediation model, the causal relationship could not be confirmed and should be further examined by more strict experimental designs (e.g., randomized controlled trial).

5. Conclusions

This study is the first to examine the relationship between five aspects of perfectionism and extra training and academic performance as well as the mediating effect of achievement motivation among Chinese collegiate athletes. We found that only certain aspects

of perfectionistic concerns and perfectionistic strivings should significant association with extra training and academic performance in the study samples. In addition, motive for success was identified as a salient mediator in the relationship between certain perfectionism aspects and extra training and academic performance. The current study provides a new perspective on the psychological mechanism of perfectionism and achievement motivation and provides the direction for future collegiate athletes to conduct extra training and improve their academic performance.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data are available by contacting the corresponding authors.

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Article

Restored Life of Elite Athletes after Spinal Cord Injury

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Abstract: Spinal cord injury (SCI) affects every aspect of human life: medical, psychological, social, material. People with SCI face a variety of secondary conditions (e.g., chronic pain, urinary tract infections, cognitive impairment) that place a significant emotional burden, resulting in an increased risk of depression and reduced quality of life. The purpose of this study was to better understand the coping strategies and to identify factors that promote or hinder the successful adjustment of elite athletes after SCI. Individual semi-structured interviews were conducted with eight top athletes after spinal cord injury. The interviews were recorded, transcribed, and then thematically analyzed using MAXQDA software. Thematic analysis identified the following categories: coping, athletic identity, and adjustment. The results of the study indicate that loss of functional ability does not cause loss of athlete identity. Elite athletes live a life consistent with this identity, attempting to maintain it despite the loss of physical fitness. Involvement in sports provides meaning and is a positive factor in the process of disability acceptance, which is essential in the process of adjustment to injury and also provides group belonging.

Keywords: spinal cord injury; elite athletes; adjustment; athletic identity; coping

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1. Introduction

Spinal cord injury carries a number of consequences affecting every dimension of human life: health, psychological, social, material [1]. In addition to loss of functional abilities, sensory deficits, bowel and bladder dysfunction, respiratory and circulatory dysfunction, and sexual activity occur [2]. In addition, people after SCI struggle with secondary conditions such as chronic pain (musculoskeletal, neuropathic, visceral), spasticity, urinary tract infections, cognitive impairment, chronic fatigue, and thermoregulatory disorders [2,3]. These factors represent a significant emotional burden and cause an increased risk of depression (which occurs in 22.2% of patients on average) and consequently reduced quality of life [4–6].

Most epidemiological data on spinal cord injury are extrapolations based on data collected in clinical settings [7]. The global incidence of traumatic SCI (TSCI) is estimated at 23/million people in 2007 (179,312 cases per annum worldwide) [8]. The prevalence of TSCI worldwide ranges from 236 to 1298/million population, and in addition to regional variations, there has been a trend of increasing prevalence worldwide in recent decades [9]. The highest proportion of TSCI caused by sport was in Russia (32.9%), followed by Fiji (32.0%), New Zealand (20.0%), Iceland (18.8%), France (15.8%), and Canada (13.1%) [10]. The sports that cause the greatest number of TSCIs in the most countries were: diving, skiing, rugby, horseback riding, football, cycling, and motor racing [10].

Such a traumatic injury and change from ones previous life requires adjustment to the new situation. There are several theories explaining the adjustment process after SCI: stage theory (Trieschmmann, 1980), response shift theories (Spranger and Schwartz, 1999), the transactional model of stress and coping (Lazarus and Folkman, 1984), and

the SCI Adjustment Model (SCIAM; Middleton and Craig, 2008) [11–14]. The latter was developed to explain all aspects of SCI adjustment by combining different models and theories. SCIAM assumes that adaptation occurs under the influence of biological, medical, psychological, social, cultural, political, and religious factors, between which there is a synergistic relationship [15]. Pre-disease factors also have a strong influence on adjustment, which occurs through the assessment of the situation in relation to modifying factors at a given time and the use of available coping strategies. When positive stressors prevail and personal resources are high, the patient perceives the situation as positive [15]. In a study by Elfström et al. (2002), three psychometrically valid and reliable ways of coping with SCI were identified: acceptance of the physical consequences of the injury, fighting spirit including efforts to maintain independence and make the best use of life in spite of the circumstance, and social resilience, which is maladaptive [16]. Optimal adjustment is led by a process that consists of the following stages: displacement, anger, bargaining, depression and desperation, and ultimately acceptance of the new reality and posttraumatic growth [11]. As long as the negative feelings of anger, sadness, and depression are transient, they do not constitute an obstacle to long-term adjustment. The development of resilience is facilitated by social support and focus on problem-solving [15].

Despite the significant emotional burden in patients after SCI, previous studies indicate health long-term psychological adjustment of individuals in this group [17–20]. In a study by Bonanno et al., with the participation of 233 participants, it was shown that most patients after SCI have significant psychological resilience [18]. Tedeshi and Calhoun (1995) introduced the term posttraumatic growth (PTG), which refers to the post-trauma achievement of a number of benefits, deeper understanding of the world or oneself, and personal growth through ways of coping with difficulties [21]. The results of Byr's (2016) study in a group of 169 individuals with paraplegia show that in terms of PTG, the highest degree of positive change was indicated in appreciation of life [22]. In this study, coping strategies such as religion, focusing on the problem, humor, and hope are 60% responsible for PTG [22]. Kalpakjian et al. studied 824 participants, with most of them experiencing PTG, and the biggest change they observed was the discovery that they were stronger than they thought [23]. This phenomenon discovered in a group of athletes with disabilities can be transferred to a group of healthy athletes finishing their careers. Smith and McManus point to the shortcomings of programs that foster positive adaptation in athletes who are ending their athletic careers and the opportunity to utilize the experience of former athletes in developing programs to help minimize stress and make appropriate lifestyle choices [24].

There are numerous studies on the involvement in adapted sports of individuals after SCI and the physical as well as psychosocial benefits of this, including improved quality of life, life satisfaction, better community integration, and the development of new friendships [25–28]. In a qualitative study by Hawkins et al., participants were elite badminton players [29]. In contrast, research on athletes who have sustained a spinal cord injury as a result of sport has been undertaken extremely rarely. In a study by Sparkes and Smith involving 14 male athletes who had suffered SCI during rugby games, the majority of subjects felt strong hope associated with a belief in recovery [30]. Badenhorst et al. describes the quality of life of 90 individuals with rugby-related SCI as higher than the control group [31].

However, to the best of the authors' knowledge, no self-reported quality of life study has been conducted to date using interviews with world-class athletes who have suffered a spinal cord injury; therefore, the material collected is a valuable and unique source of information. The purpose of this study was to explore the life histories of the subjects and to provide a thorough analysis that allowed for a deeper and better understanding of the coping strategies they use and to identify factors that promote or impede the successful adjustment of elite athletes after SCI.

2. Materials and Methods

This paper deals with the life histories of eight prominent athletes who suffered spinal cord injuries. A descriptive–qualitative method was used in the study.

2.1. Participants

The following inclusion criteria were used: sport achievements at the minimum national level (winning a medal in at least one sporting event of national rank) before SCI, spinal cord injury (tetraplegia or paraplegia), and informed consent to participate in the study. Due to the nature of the study, participants included in the project had to know either Polish or English to a degree that allowed free communication and understanding.

Based on the available internet sources, sports committees on spinal cord injury among elite athletes were reviewed. Consequently, 32 subjects meeting the above criteria were selected and sent invitations to participate via e-mail. Sixteen subjects responded positively to the invitation, but three did not meet the inclusion criteria and five did not return the consent to participate in the study. Sociodemographic and SCI data are presented in Table 1.

Table 1. Sociodemographic data of study participants. C-cervical spine, Th–thoracic spine, L–lumbal spine.

Participant	Age	Gender	Nationality	Level of SCI	Years since Injury	Discipline before SCI	Sport after SCI
P1	41	Male	British	C3/4	14	BMX dirt jumps	No
P2	29	Male	Austrian	C6/7	5	Ski jumping	Rugby, skiing
P3	24	Female	Polish	Th11/12	6	Karate	Wheelchair dancing
P4	37	Male	British	C4/5	16	Rugby	No
P5	45	Female	Canadian	Th12/L1	14	Mountain Biking	Wheelchair basketball
P6	31	Male	British	Th6	15	Motocross	Car race
P7	40	Male	Polish	Th11	17	Judo	Canoe
P8	47	Male	Polish	L1/2	15	Speedway	Hand cycling

To conduct the study presented in this paper, the authors obtained the consent of the Senate Research Ethics Committee of the University School of Physical Education in Wroclaw, Poland (corresponding ethical approval code: 37/2018, art.27, Dz.U.1997, poz.553). Study participants gave informed consent both to participate in the study and to the publication of its results in accordance with the guidelines established by the Declaration of Helsinki.

2.2. Study Design

The final participants in the study were elite athletes who were interviewed and returned completed sociodemographic questionnaires. Figure 1 shows the study design along with the recruitment stage of the participants.

The study used semi-structured interviews, which is the most commonly used method of qualitative research in the health care field [32]. Due to the fact that participants live in different regions of the world, the interviews were conducted via instant messenger, recorded, and then transcribed. This made it possible to conduct each interview at a time and place most convenient for the participant, which contributed to a more productive interview process. Prior to the interview, participants were given a consent form, which included a description of the project, its purpose, and rules of ethics and anonymity, which they read and verbally agreed to at the beginning of the interview. The interviews were conducted by the second author. The duration of each interview was between one and a half and two hours. The interviews consisted of key questions that helped define the areas the authors wanted to explore while allowing the interviewee to speak freely. The

flexible format of interviewing allows for the discovery and development of information important to the participant [33]. Once verbal consent to participate was obtained, the interview began with a general, simple question, "Please tell us something about yourself", in order to help the respondent feel at ease, build trust and rapport, and ultimately obtain valuable and worthwhile data addressing more sensitive and difficult topics [33].

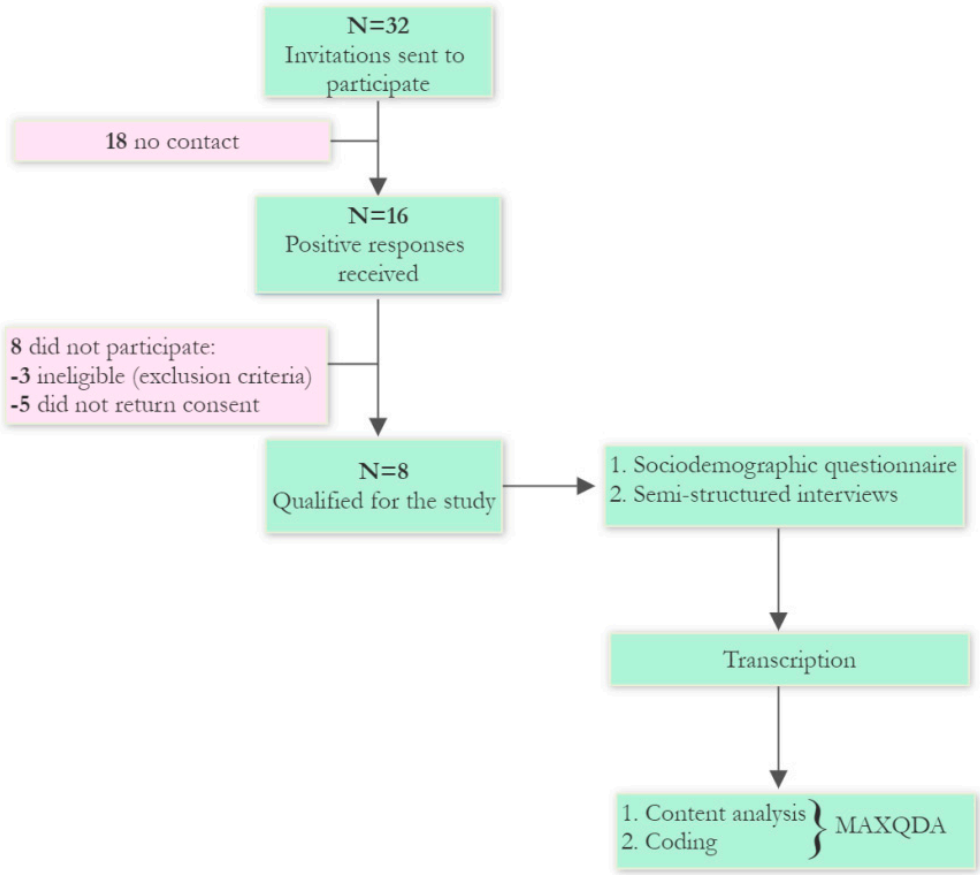

Figure 1. The flow chart of the study design.

2.3. Data Processing and Analysis

Data were collected in 2019–2020 from the semi-structured interviews. MAXQDA® version 2022 software (Release 22.1.1, VERBI GmbH, Berlin, Germany) was used to organize the data for qualitative analysis and coding. The thematic analysis of the content of the interviews proceeded in several stages. In the initial stage, two researchers analyzed each statement by giving it a label similar to the terms used by the respondents. In this way, semantic units or codes corresponding to the main idea were extracted. In the second stage, the researchers focused on the analysis of subcategories, where units of similar meaning were organized into categories. Eventually, three main meaning categories were identified: (1) sport identity, (2) coping in the initial pattern of reaction to the accident, and (3) adaptation in the long-term pattern of behavior after the accident.

3. Results

Following the thematic analysis, three categories emerged: coping, sport identity, and adjustment. The themes along with the categorization and matching quotes are presented in Table 2.

Table 2. Topics by subcategory.

Category	Subcategory	Quotation
Coping	Struggles	*P1: It is really difficult, your mental challenge is to keep going. Everything was a challenge when I woke up.*
	Fighting Spirit	*P7: I got into rehabilitation, intensive rehabilitation, which was replacing my sports training, and it lasted a couple of years.* *P8: "The sports anger in me woke up, I said to the doctor, you'll see I'll prove it to you I'll come in on crutches, whatever.*
Athletic Identity	Fans' support	*P1: I was very lucky because it was quite public. I was highlighted a lot from my crash. People in sports insurance were amazing, they have set up the fund, and people were donating money*
	The advantage of being an athlete	*P3: Karate before the accident taught me perseverance and diligence, which came in very handy later in this daily struggle.*
	Interaction with the sports community	*P2: The connection is still here and it's always fun to watch them at their training, and it's even more fun when I try to use their exercises for my training. And another thing is I just stand before coach exam, so I can train young ski jumpers. I wanted to stay here because i really lived in this area because of ski jumping and training. This is the middle point of my life.*
		P4: with Leicester Tigers, I coach sometimes. I support beneficiaries for Leicester tigers charity. It's pretty good really
		P5: and that gave me purpose and that was helpful for me but when that race ended and all through, but it gave me a purpose to get out of bed and to do something and so that was the that was sort of the baby steps.
Adjustment	Finding the meaning of the accident	*P2: I stopped to complain about things which I cannot change. That I think, was one of the best things i learned because this save so much energy.* *P3: For sure life is reevaluating and I am so positive people admire me because I don't worry about trivial things. P4: I believe, my accident happened for a reason so I can support young people who have a similar injury to me but don't have that support I received.*
	Motivation sources	*P1: My kids, yeah. That's the main thing that keeps me going.* *P1: After some time I was able to keep myself standing, it was so good for my mental condition, it was so inspiring and motivating.* *P2: When you see other people being proud of you because you just managed to move in the wheelchair.*
	Disability acceptance	*P5: I ended up I love the fact that I'm part of this community.*
	Goals, plans	*P1: I just want to do more motivational talks, raise my boys, they are great kids.* *P2: I want to raise the focus of the public when they build things to think about disable* *P4: The ambitions in my life is to make a foundation full of friends and spread the word about disability. I think as well we are changing the world for many disabled people, we empower them to do their best, make the most of their lives, try to look at the positives of their lives* *P6: at the minute my big goal is to compete the best I can with my disability in racing.*

3.1. Coping—An Early Adaptive Pattern

Participants described various ways of coping with a difficult post-accident situation. These included a variety of behaviors or defense mechanisms to protect against an existential sense of threat. Analyzing the interviews, we identified the following adaptive strategies: rationalization, repression, denial, postponing the cognitive confrontation with the consequences of the accident, analyzing/reflecting on the causes of the accident, seeking information about the chances of walking, learning about conventional and unconventional treatments, believing in God, seeking to make sense of the accident, behaviors to relieve tension such as crying and seeking contact with relatives and friends, and working. By adaptive pattern, we mean the presence of different coping strategies and the functions they perform. We observed the above strategies in all cases, although in different configurations and with varying degrees of intensity. We did not observe any recurring pattern in the order

of their occurrence, co-occurrence, or intensity. They also varied over time depending on their effectiveness. Their function was to bring about emotional and cognitive equilibrium and to reduce feelings of existential anxiety.

Up to the point of SCI, the participants had experienced accidents, and there were already shorter or longer moments of interruption in their athletic careers. They were aware of the risk of accidents and did not dwell on the thought that a serious injury such as SCI could befall them, especially since it was extremely rare in the sports they practiced. An accident is a turning point in the lives of participants who have played sports professionally. P1 emphasizes how difficult a mental challenge this incident was:

P1: It is really difficult, your mental challenge is to keep going. Everything was a challenge when I woke up.

P4: There were some dark days, and I really struggled initially but I had such a lot of support

P2 was aware from the first moment of the severity of the injury and the difficulties he would face. He points to the very important words of the doctor who gave him the diagnosis.

P2: I interrupted him 'That means I'm paralyzed from now on. Is that right?' and then he said 'Yes' that was the moment that brought some tears to my eyes. Then he continued talking immediately what was very important because he said 'I have to remind that today I have a healthy head, a healthy mindset, and quite healthy hands, and these components make sure that I can have quite normal life. Yea and maybe this was the most important sentence in this whole journey which I'm since that day.

In contrast, P3, in retrospect, doesn't even remember the moment of collapse.

P3: From the very beginning I had a positive and fighting attitude. I didn't understand myself fully but I didn't have a single moment of breakdown.

P6, in the first moment after opening his eyes, felt lucky to be awake and still alive despite such a serious accident. Regardless of the shock experienced and the challenges posed by the consequences of SCI and the initial struggle, the participants were set to fight. Contrary to the diagnosis they had heard, the participants were eager to prove it wrong and were confident of a complete rescission, focusing on intensive rehabilitation.

P7: I think in psychology it is described somehow, some kind of denial that I can do it. That 99 out of 100 couldn't make it, but I can make it. This is related to what I said, that after the accident I spent several years on rehabilitation, that very hard, professional work will have some effect, and although history teaches us that in some cases there is no effect. I explained to myself that there was no effect because these people were not determined enough, but I explained to myself that if I spent years I would think I would succeed.

At the same time, the hope of fully recovering allowed some to survive the most difficult initial moment:

P5: It was good that I had the hope that I had. I was 100-percent convinced that I was going to walk out of hospital. Without this hope, it would be so much more depressing.

3.2. Sports Identity

Analyzing the interviews, we noticed that the participants constructed their "self" in the area defined by the culture of the sports group they belonged to before the accident. These groups provided them with specific categories to describe themselves. Their personal identities were responses to questions about strong relationships with the sports group, parents, coaches, or athletes as important people in their lives. Membership in a particular professional group was therefore an acquired identity, formed as a result of group membership and consciously chosen. In the pre-traumatic past searches for answers to the questions Who am I? Who am I supposed to be? Who do I want to be?, our participants had constructed their sport identities:

P8: My life has always revolved around sports because my dad was a sportsman Well, I must have been soaked in it like a shell of an egg and this sport was absorbed by me as well Well, there was still some soccer later on because there was also speedway Well, I ended up on this speedway the way I ended up, Skiing and cycling were also passions that I continue somewhere now because I also ski and cycle, so it was such a cool life because maybe in the summer I rode speedway, cycling and then came winter. Since autumn I was already skiing because I also had a ski school. Also I was teaching skiing some trips we organized, training for children for adults of all ages and such a life to envy . . .

Participants after their accidents found certain advantages of having been athletes: physical strength, support from fans and sponsors, and opportunities for impacts on the lives of others:

P2: They also knew about that I was a sportsman so I could handle some things a bit better.

During their conversations with us, they referred to their sports past and planned for the future. They expressed the need to belong to their previous sporting environment and to identify with their immediate surroundings. Despite the fitness loss, they did not lose their identity. In accordance with their vision of themselves, they set new goals and chose ways to achieve them. They sought out activities and lived their lives in such a way as to live up to that identity even though they lacked functional capabilities. Achieving identity–life compatibility helped them to accept their disability at the same time:

P5: My identity has always been of an athlete and so now not to have that as my identity was frightening really scary during that time. ..... I think all of these things sort of happening when they happen gaining my confidence back from tennis and basketball. You know sort of being more outgoing. Where is for a while i was such an introvert because I didn't know I was not comfortable with myself. So you know it's taking a long years. You know what I think it's different for everyone in a chair. I learned to be totally ok with myself and that changed a lot for me not only in sport and to make the connections that I've made and to be able to talk about you know an accident and my process and my journey throughout the whole thing.

Most of the participants took up sport activities by changing the discipline: P2 rugby and skiing, P3 wheelchair dancing, P5 wheelchair basketball, P6 race car driving and handcycling, P7 canoeing, and P8 hand-cycling.

P7: I saw it and it made me feel really stupid, ashamed. Because I saw, let's call it broadly, people like me, and they were lifting such weights . . . How do we count these circles? How many are there? And at that moment the athletic soul was awakened, the perversity that I also have to here. And that was the beginning.

P8: . . . in fact life didn't end that you can still do sports, maybe a little bit in a different form because unfortunately for that you need some kind of special equipment, but it was possible. Well there was some kind of a signal that I was saying that he can continue to do that skiing that I used to do before the accident, I'm still doing it, and that's how it went.

Participants are also involved in sports life as coaches, as co-organizers of events, and as heads of foundations they started to support athletes after SCI.

P3: I still sometimes take part in, appear at the start or finish line of, for the benefit of the earth, or marathons, also supporting runners, because I myself enjoyed running before the accident. And after the accident, from friend to friend, it so happened that I also support the runners. Also at some stops, finish line or start I am with them. I don't run marathons with them because my arms would fall off, but at least this way I spend time with them

3.3. Adjustment—A Long-Term Adaptive Pattern

Because of the long time that had passed since their accidents (5–17 years), these participants had gone through various stages of adjustment and were currently in the stage

of coming to terms with the consequences of the injury and experiencing posttraumatic growth. By analyzing the interviews, we distinguished: (1) psychological resilience as evidenced by regaining meaning, (2) finding motivation to live both externally and internally, and (3) behavioral recovery-setting goals such as undertaking new sporting and advocacy activities. By long-term adaptive pattern, we mean the presence and functions of different coping strategies they had used over the years of their recovery. Their aims were primarily to maintain a state of emotional and cognitive balance, to come to terms with the consequences of the injury, and to experience posttraumatic growth in the new reality.

3.3.1. Finding the Meaning of the Accident

A complete acceptance of post-accident reality is evidenced by finding meaning and positive aspects of the incident. P3 points out how much she has learned and achieved and how life in a wheelchair has opened up new perspectives and opportunities for her. P2, because of winning the court battle for compensation with the sports committee, unequivocally states: "at least now my wheelchair has a reason". P2 and P3 have reevaluated their lives and, thanks to the accident, do not complain about small adversities. They always try to see the positive aspects of every situation. P4 finds meaning from the accident in being a support for other people:

P4: I believe, my accident happened for a reason so I can support young people who have a similar injury to me but don't have that support I received.

3.3.2. Sources of Motivation

For participants, sources of motivation are their families, the positive effects of the work they put into rehabilitation, and the admiration of others present in their lives:

P1: After some time I was able to keep myself standing, it was so good for my mental condition, it was so inspiring and motivating.

P2: When you see other people being proud of you because you just managed to move in the wheelchair.

Participants are also motivated by the stories of other people with disabilities who lead happy and fulfilled lives despite their disabilities.

P3: I watch motivational speakers on youtube who are also struggling and overcoming these barriers.

An additional motivation for both P7 and P8 are their rivals and people who make things difficult for them:

P7: Negative motivation, I will tell you what it is, in short, it means that when someone throws obstacles under my feet and is motivated by some, I don't know, malice, which I experienced. This motivates me very much to show them, to rub their noses in it.

3.3.3. Acceptance of Disability

At first, the participants were fully resistant and did not identify with the world of disabled people. With time, they started to realize themselves in another sport and to integrate into the society they started to belong to.

P5: I didn't want to be around anyone in a wheelchair because that made me really realise that was my world but when I did and it was when I started to go out to the tennis practices and I would hang out with everyone that was playing at the time. It makes it a little bit more bearable and so like. I ended up I love the fact that I'm part of this community.

They discovered that despite their disabilities, they could continue to be happy and lead fulfilling lives:

P2: Training, working, being outside, that wheelchair live is possible.

P4: For once I didn't feel pity because of my situation. That's amazing.

P3 also aims to break stereotypes and make people aware that people with disabilities need full acceptance and want to live normally, without drawing unnecessary attention to themselves:

P3: I try to show that a person in a wheelchair is not a freak but a normal person who needs normality, tenderness, and to be with other people.

Acceptance of one's condition is evidenced by the ability to freely tell one's story including the circumstances of the accident to motivate both the disabled and the healthy communities with one's attitude:

P8: Some companies motivate employees and show them that they are complaining having actually everything having arms, legs they are there complaining that they don't want something and this shows them that they are half the guy that is 50% and doing twice as much work as them.

P4 and P8 have set up foundations to support and bring together post-injury athletes and share their experiences and journeys. P8 is also a lecturer in sport and tourism for people with disabilities.

3.3.4. Goals

Each of the participants was able to identify specific goals they were currently setting for themselves. Some gave general goals unrelated to the accident: to be happy, to start a family, to rear children, to finish building a house. Goals directly related to the accident concerned the continuation of rehabilitation and the improvement of functional abilities:

P2: I have reached all my milestones. In my situation now my goal is to improve my walking on crutches, or without crutches.

At the same time, experiencing difficulties related to the wheelchair, P2 sees the need to adapt spaces to people with disabilities and to remove architectural barriers:

P2: I want to raise the focus of the public when they build things to think about disable.

Further objectives are to support people with disabilities by giving motivational speeches and, in the case of P4 and P8, to propagate and review the activities of the foundations they have established:

P4: The ambitions in my life is to make a foundation full of friends and spread the word about disability. I think as well we are changing the world for many disabled people, we empower them to do their best, make the most of their lives, try to look at the positives of their lives. That is massively important in this situation. We just try to give people hope that they can move on with their life. We try to give them a purpose to wake up every morning. that's really important.

P5, P6, P7, and P8 changed sports but continue to play sport at a professional level, so their goals also include further achievements in this area.

4. Discussion

In this study, we presented the thematic analysis of the responses from eight interviews with elite athletes who sustained spinal cord injury during their sport careers. The analysis aimed to provide key information about the process of adjustment to the new post-injury reality and the factors that led to the recovery of emotional balance and a satisfying life despite the consequences of SCI.

Of the three strategies listed by Elfstrom et al. for coping with SCI in the first period immediately after the accident, participants in our study used fighting spirit [16]. It involved undertaking intensive rehabilitation and hope for restitution, which, as P5 points out, enabled her to survive the most difficult moment. On the one hand, conveying an adequate diagnosis and realistic chances for the patient are important, but on the other

hand, hope should not be taken away as it is essential in the fight. In the qualitative studies by Hawkins et al. and Smith, participants' hope was also generated from the prospects of a cure in the future [29,30]. However prolonged, unrealistic hope and lack of acceptance is a significant barrier to achieving optimal adjustment. Pollard and Kennedy indicated that something that happens immediately in the post-injury period has profound implications for adjustment later [19]. This points to the important role of intervention by health professionals as those who interact with patients directly in the pre-injury period. P2 still paid particular attention to the words of the physician despite the lapse of 5 years since the accident (see results section). In a study by van Diemen et al., participants found the motivational attitude of professionals to be stimulating, which was seen as a post-positive element of mental adjustment [34].

Erik Erikson believes that identity is a sense of being special while at the same time being integrated into a social frame of reference in which one plays a role [35]. In the literature, there is a notion of group identity, which is a way of defining oneself by belonging to different types of social groups. The common factor that characterizes all participants in this study is their athlete identities, which, irrespective of the consequences of SCI, is still the apex in the identity hierarchy. The social frame of reference for the subjects was the groups of athletes they had come from. Coming to one's own athletic identity is a long, arduous process. The SCI that emerged, although it was a hindrance to self-realization and caused internal conflicts of tension, still constituted the identity status quo of our subjects. Constructing one's personality and sense of self along with hopes for the future based on pre-injury life was also observed among the respondents of Zuchetto et al.'s study [35]. Sport identification can affect individuals experiencing SCI in two ways. Cases have been reported in the literature where strong athletic identity hindered or even prevented the adaptation process [36]. An extreme example is a former professional rugby player committing suicide after SCI [37]. On the other hand, athletic identity can be used as a facilitator of recovery and support positive long-term adaptation [25,26]. During the preoperative period, the participants in our study experienced shock and loss, which was compounded by the thought of losing the opportunity to play sport. As time passed and the participants slowly accepted and embraced their disability, they began to explore ways and opportunities to maintain, continue, or even enhance their sport identity, which was an important step in the adaptation process. The greatest limitation that cannot be eliminated is tetraplegia with a complete lack of functional ability to participate in even paralympic sports [38]. According to Sparkes, the experience of an injury that threatens the fulfillment of the role of athlete negatively affects the personal identity of individuals who strongly identify with that role [39]. This could suggest a serious problem without a solution for professional athletes experiencing SCI at level C5 or below. However, it is an interesting observation that P1 and P4, with high spinal cord injury above the fourth cervical vertebrae, found opportunities to pursue a sport identity. As it turns out, it can also be rewarding to passively participate in sporting events, to be a coach for a sport one previously played, to organize sporting events, and to run a foundation to support athletes who have suffered SCI. Other participants began to become involved in disability sports, and new group affiliations began to define changes in social identity, successively leading to changes in behavior. The meaning and value of membership in the new community provided an important potential for positive adherence to therapy, as has been observed in previous research [38]. In a study by Tasiemski and Brewer (2011) with 1034 individuals with SCI, amount of weekly sport participation was positively related to athletic identity, and team sport participants reported better psychological adjustment than individual sport participants [38]. In a study conducted on a group of 80 patients after SCI, participants who took part in regular physical activity had better fitness, greater independence, and better functional status [26]. Furthermore, Silveira et al. in a study of 150 males with tetraplegia noted a correlation between the frequency of sports participation and reductions in psychological distress [27]. A good predictive model for sport participation of individuals with acquired physical

disabilities is the Health Action Process Approach (HAPA), which may be valuable in preparing sport promotion programs for populations with SCI [40].

Participation in sport for people with disabilities has been very helpful in their acceptance of their disabilities, which is extremely important because the lack of ability is a significant barrier that must be overcome in order to achieve positive adaptation [19,41]. Unfortunately, according to Perrier et al. (2015), only about 3% of individuals with acquired physical disabilities participate in sport, while 50% of individuals in this group expressed interest in being able to participate in adapted sport [42]. This indicates the need to promote sport in this population. The participants in our study and their stories can serve as examples for both elite athletes and other people with disabilities. It is worthwhile for health care professionals to have information on foundations supporting people with SCI in their country, as this can be important information for the patient and an important step in starting a positive adaptation to a new life situation. P4 and P7 have set up foundations that aim to facilitate the difficult process of adaptation, and the stories of elite athletes can be a valuable example that you can lead a fulfilling life despite your disability. Additionally, familiarity with the stories of elite athletes can be a helpful guide that health care professionals can use in their work with patients to build motivation, foster positive thinking, and develop the drive to be as independent as possible.

Athelstan and Crewe (1979) found that individuals who were injured as a direct result of their own behavior were better adapted than those who were injured accidentally, which applies to all participants in our study except P7 [43]. Participants in our study came to a reflection that allowed them to make sense of the accident and, further, to list the many benefits and changes in themselves that it brought. As in previous studies, participants indicate a greater appreciation of life and their health, a reduction in complaining, and the discovery that they were stronger than they thought [18,19,40].

As authors of the paper, we recognize limitations of our study, which are primarily related to the specific study group of elite athletes with SCI. The inclusion criteria used may have influenced the size of the study group, although we made every effort to find as many elite athletes after SCI from different continents as possible, analyzing a twenty-year period. The authors are aware that the number of subjects is a limitation, but this is the first international project related to the different aspects of the quality of life among people after SCI, as well as among elite athletes after SCI. We therefore hope that the results obtained in this project can be used as valuable and interesting material for further comparisons. Participants included int this study lived on different continents, which was why it was only possible to conduct this study remotely. The authors are also aware of the susceptibility to selection bias, as the number of participants was clearly lower than the number of people invited to the study (the project eventually included 8 participants out of 32 to whom the invitation was extended). There is therefore a likelihood of potential bias due to the fact that the subjects may have had more positive life experiences. However, the work aims to show that despite the traumatic injury, people who receive sufficient support and participate in sports find identity, belonging, and life satisfaction.

5. Conclusions

Despite the loss of fitness, elite athletes do not lose their identities. They live lives consistent with this identity, attempting to maintain it despite the loss of physical ability. Involvement in sports provides meaning and is a positive factor in the process of accepting disability as a necessary part of the adjustment process while providing group belonging. Most important is environments of people who can offer different perspectives or simply listen to them. It is therefore important for medical personnel to focus on not taking away hope as it is helpful for getting through the most difficult initial stage after the injury. There seems to be a particular role for the physiotherapists who work with such patients to help the patients look for ways in which they can realize and continue the lives they have led so far and to encourage them to, if possible, maintain or redefine particular identities. Since it is known what support effects are observed in elite athletes after SCI, it is advisable to

apply appropriate support and strong promotion of participation in adapted sports, which would allow for expecting similar effects in the average patient population.

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Data Availability Statement: The datasets used and analyzed during this study are available from the corresponding author upon reasonable request.

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

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Perfectionism, Resilience and Different Ways of Experiencing Sport during COVID-19 Confinement

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Abstract: The relationship between sports practice and physical and mental health became an important issue during the COVID-19 pandemic, where keeping fit and exercising was one of the best and most popular ways to cope with the confinement situation. The aim of this study was to determine the relationships between perfectionism and resilient resources with psychological well-being, differentiating sports category, gender and experience in a sample of athletes during confinement in different countries affected by the COVID-19 pandemic. An incidental and cross-sectional random sampling method was designed (n = 583). The sample was analysed with three different instruments, evaluating perfectionism, resilience and psychological well-being patterns and comparing three groups with different levels of practice due to confinement (full reduction, moderate reduction and only access restrictions). Results show that both male and senior athletes were more organized, resistant to changes and focused their attention and efforts on their demands and potential. They were stimulated by obstacles that required more effort compared to U23, who reported higher concerns and lower organisational scores. Athletes who completely interrupted their sports dynamics showed higher indicators of perfectionism and performed worse in resilience and well-being. Despite this, age and the variability of the athletes' experiences proved to be relevant factors in an athlete's trajectory, and continued to represent a certain degree of balance in the face of COVID-19.

Keywords: psychological well-being; adaptive perfectionism; maladaptive perfectionism; resilient resources; athletes; culture; pandemic

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1. Introduction

Perfectionist research has a long history of study in psychology, both in clinical research and in research on the personality adapted to sport, where the unadaptive or the consequently negative effects (e.g., feelings of failure, indecision, and shame) derived from it have been recognised as a relevant variable for understanding aspects such as depression [1], social phobia [2] or somatic symptoms [3]. On the other hand, it is also interesting how perfectionism in sports situations has shown an ambiguous influence that sometimes has been associated with functional responses (e.g., mental toughness; self-presentation) [4], and in others with dysfunctional ones (e.g., isolation, burnout, exercise dependence) [5–7].

The appearance of the COVID-19 disease caused a significant break in everyday life. Given its characteristics, the entire world found itself in an unprecedented situation of confinement and athletes were not exempt from these figures and measures [8]. The state

of confinement by COVID-19 proved to be complex to high-performance athletes and it is not yet known how the implemented quarantine measures could affect the physical and psychological aspects of high-performance athletes in the short and long term.

Regular, healthy physical exercise programmes or activities improve mental health, autonomy, memory, speed, body image, and sense of well-being while producing personal stability, improved mood, and improved health. Psychological well-being in sport focuses on the development of skills and personal growth, both conceived as main indicators of positive functioning [9]. In performance-oriented athletes, both perfectionism and resilience work in a similar way, although the circumstances generated by COVID-19 are much more decisive and uncertainties may have diminished many of their hopes and expectations for achieving their sporting goals. It has been hypothesized that in the short term there has not been an acute increase in injuries in professionals, but that in the long term it is unfolding as a burden for high-level sport [10]. However, it will still take time to understand the real impact of COVID-19 pandemic confinement, not only on the physical, but also the mental health of these athletes [11].

Personality is a determining and mediating factor in people who play sports, and a clear difference appears both in those with perfectionist or attention to detail patterns and in those who face adverse situations and difficulties [12]. Usually, people with perfectionist traits tend to worry too much about situations of uncertainty, showing a weak ability to manage stress [13]. On the other hand, people who usually find resources to face adversities (resilient) are more able to tolerate uncertainty and be more positive regardless of the difficulty. The former will live with a lower perception of psychological well-being, while the latter will be more motivated and able to see the future with even greater optimism and hope [14].

Most perfectionist athletes have grown up in environments where love and approval are conditional; so, to feel the love and approval of people they must execute their actions with high levels of perfection. Over high doses of negative self-criticism, any failure or mistake brings with it the risk of being rejected by close contexts of influence (e.g., parents or coaches), thus losing their closeness or affection and feeling that they establish criteria (e.g., expectations) that they cannot meet, with failure meaning a potential loss of contextual acceptance [15–17]. Building on high expectations without the proposal of high standards will lead the most perfectionist athletes to be more sensitive to concerns and uncertainties about actions to be taken, leading to emotional (e.g., anxiety), cognitive (e.g., rumination) and behavioural (e.g., control motor) alterations.

Resilience starts to be considered one of the main mental resources in adaptive behaviour towards the processes of change and improvement [18]. It is a variable dependent on several factors such as emotions, supports, experiences, strategies, motivation and self-concept [18,19], based mainly on two concepts, overcoming adversity and positive adaptation [20], with an important component of psychological readjustment [21].

In sports contexts, it is developed from the cognitive, physical and social level to be able to control the threats that may affect the sportsman or woman [22], it influences both personal and sports growth [23]. Their positive relationships with confidence, positive personality, motivation, social support, and concentration act as facilitators for adequate performance in sports performance contexts, or adherence to active lifestyles in healthier orientations. Although, of all these variables the most important for the development of resilience is the belief that the athlete must overcome adversity and the close environment (e.g., family) [24].

Although it is not possible to be too forceful, as resilience is an emergent topic in sports settings [25], resilient resources increase with age [26]. There are studies that show no difference in levels of resilience between men and women [27], and others that point to higher levels of resilience in men, based on a better perception of personal competence [12]. Concerning the sporting experience, the results are also contradictory. Some studies point out that athletes with a higher level of competition are more resilient than amateur athletes [28]. In contrast to this, other literature shows a relationship in which sportsmen

and women with less sporting experience have greater resilience [29–31]. Morgan et al. [32] presented a study with different focus groups, associating resilience to perceived support among athletes, highlighting their dynamic and systemic qualities that protect from stress, enhancing individual and collective effectiveness. In this sense, the most experienced athletes were indicated to have and to handle greater resilient resources than those indicated by younger or promising athletes.

This study aimed to describe the relationship between perfectionism and resilient resources with psychological well-being. After the literature review, the proposed hypotheses are: (a) worse results of perfectionism and resilience will appear as the time in confinement is longer, (b) more experienced (senior) athletes will show a greater capacity to manage their psychological response during the confinement situation, (c) men will show better indicators in both adaptive perfectionism and resilience and therefore greater psychological well-being, and finally, (d) both women and U_{23} athletes will show greater results in maladaptive perfectionism.

2. Materials and Methods

2.1. Desing, Participants and Procedure

A transversal, quantitative and non-random study was designed to differentiate the sports category (U23 vs. senior), gender and the practice of sport during the confinement both in South American and Spanish athletes and different levels of impact by the COVID-19 pandemic. Inclusion criteria for participating in the study were: (1) to be part of a Technification Plan of a Sports Federation and to consider competing in sport as their main activity.

A sample of 583 athletes (M = 26.63 years; SD = 6.74) from different cultural backgrounds ((n_{Spanish} = 309; 53%); ($n_{\text{South American}}$ = 274; 47%)) was analysed. The sample distribution by gender included n_{men} = 336 (57.6%) and n_{women} = 247 (42.4%), and by category including senior athletes (n = 300; 51.5%) and U_{23} athletes (n = 283; 49.5%). The sample was distributed in: complete reduction in their sports practice during confinement (n = 343; 58.8%); moderate reduction (n = 154; 26.3%); or only access restrictions in their sports facilities (n = 86; 14.9%). Three levels were established when describing the type of confinement suffered by sportsmen and women: (a) full confinement (total confinement, with no possibility of training); (b) moderate confinement, with the possibility of training at home (exceptionally in open or sports facilities, but not in competition), and (c) non-confinement (sportsmen and women who have continued their training in controlled situations, mainly in institutional or private sports facilities). Data collection was carried out during the first half of 2020 in different High-Performance Centres in different countries (Spain, Chile, Costa Rica, Argentina, and Colombia). Before data collection, the following procedure was defined: (a) virtual meetings to request federative permits; (b) sending to athletes (via federation) a letter/document addressed to athletes, explaining the goals and process of the research, including the voluntary nature and the commitment to ethical and confidential compliance. At the same time, measures battery was designed with Google form platform, which was sent to the athletes who agreed to participate, including an informed consent under descriptions of Declaration of Helsinki [33] and the protocol approved by the Ethics Committee (ID: 1494/2020).

2.2. Measurement Instruments

Initially, a short questionnaire was designed ad hoc to describe previous considerations of the sample. This included aspects such as gender, age, country, sports experience and how limiting the confinement was in continuing with their sporting lives.

Perfectionism. The Spanish adaptation of the Multidimensional Perfectionism Scale (FMPS) [34] by Carrasco et al. [35] is used. It consists of 35 items describing 4 first-order factors (Achievement Expectations, Organization, Fear of Errors and Parental Influences), 2 s-order factors (Adaptive Perfectionism and Maladaptive Perfectionism) and 1 third-order factor (General Perfectionism). The answers cover a Likert scale from "*strongly disagree*"

(1) to "*strongly agree*" (5). For the present study, the second-order factors are used, which yielded reliability values for both adaptive perfectionism (α = 0.86) (e.g., "*the organization is very important for me*") and maladaptive perfectionism (α = 0.83) (e.g., "*The fewer mistakes I make, the more people will want me*"), while the CFA showed a good fit (X^2/gL = 11.73; *p* = 0.00; CFI = 0.89; NNFI = 0.91; CFI = 0.92; SRMR = 0.05; RMSEA = 0.05).

Resilience. The Spanish version of RS-14 Scale [36] was used [37]. This scale is composed of 14 items grouped in two dimensions measuring personal competence [(11) items; self-confidence, independence, decision, resourcefulness and perseverance; (α = 0.78) (e.g., "*I am not afraid to suffer difficulties because I have already experienced them in the past*"), and self and life acceptance (3) items; adaptability, balance, flexibility and a stable life perspective; (α = 0.84) (e.g., "*I am a person with adequate self-esteem*")]. Responses were collected on a 7-point Likert scale ranging from "*strongly disagreeing*" (1) to "*strongly agreeing*" (7). The internal consistency analysis of the current study for the sample collected has proved satisfactory (α = 0.80), showing an adequate fit (X^2/gl = 8.51; *p* = 0.01; CFI = 0.91; NNFI = 0.91; CFI = 0.95; SRMR = 0.07; RMSEA = 0.04).

Psychological well-being. The Spanish adaptation of Ryff's psychological well-being scales [38], by Díaz et al. [39] with a Likert orientation of (1) "*strongly disagree*" to (6) "*strongly agree*", is described by 29 items, grouped into 6 first-order factors (self-acceptance, positive relationships, autonomy, mastery of the environment, personal growth, and purpose with life) and 1 s-order factor (psychological well-being). The second-order factor will be used for this study, which showed a reliability α of 0.89. Confirmatory analysis (CFA) maintains the one-dimensionality of the original version (X^2/gl = 10.31; *p* = 0.00; CFI = 0.92; NNFI = 0.94; IFC = 0.92; SRMR = 0.06; RMSEA = 0.05). Some examples of items are: "*When I review my life history, I am happy with how things have turned out*", "*I often feel lonely because I have few close friends with whom to share my concerns*" or "*I tend to worry about what other people think of me*".

2.3. Data Analysis

Descriptive statistical analyses (measures of central tendency, frequencies, homogeneity) and confirmatory factor analyses (CFA) were completed using the following indicators: Chi-square (χ^2), Akaike Information Criterion (AIC) [40], Comparative Fit Index (CFI), Non-Normed Fit Index (NNFI), Standardized Root-Mean-Square Residual (SRMR) and Root Mean Square Error of Approximation (RMSEA). For an adequate adjustment of the data, the lower the values of X^2, AIC, NNFI and RMSEA, and the higher those of CFI and NNFI, the more reliable the information obtained would be. The parameter estimation by maximum likelihood (5000 bootstrap samples with bias-corrected confidence intervals 95.00), d Cohen and Cronbach's alpha are carried out to consider the internal reliability of the instruments and differential analysis. Pearson's correlation analyses were completed to determine the degree of the linear relationship between the variables under study (controlling for gender and category variables). Finally, the multivariate analysis (MANOVA), for the differential description according to gender and category, was completed. The statistical programme used for these analyses is SPSS (IBM), with version 25.

3. Results

Table 1 reflects the descriptive statistics at each of the three levels established when describing the type of confinement suffered by sportsmen and women.

We analysed the calculation of the correlations ("zero-order") between wellbeing and each one of the other variables, controlling the effect for the gender and category (Table 2). When analysing the linear relationship between the variables studied, it becomes clear that in both the Spanish and South American samples, as age increases (and therefore also the sporting experience), the indicators of resilience and adaptive perfectionism increase significantly (although the links with adaptive perfectionism are poor), while maladaptive perfectionism decreases according to increased sports experience and psychological wellbeing. Concerning the variables between them, adaptive perfectionism shows a positive and

significant relationship with personal competence and acceptance, while the relationships are significant and negative with maladaptive perfectionism.

Table 1. Sub-samples distribution differentiating between confinement levels.

n = 583	Spanish Athletes (*n* = 309)				South American Athletes (*n* = 274)			
	Gender		Category		Gender		Category	
	Male *n* (%)	Female *n* (%)	U23 *n* (%)	Senior *n* (%)	Male *n* (%)	Female *n* (%)	U23 *n* (%)	Senior *n* (%)
Full confinement (*n* = 343)	114 (33.3)	74 (21.6)	92 (26.8)	96 (27.9)	97 (28.8)	58 (16.9)	79 (23)	76 (22.2)
Moderate confinement (*n* = 154)	39 (25.3)	34 (22.1)	41 (26.6)	35 (22.7)	42 (27.3)	39 (25.3)	35 (22.7)	43 (27.9)
Non confinement (*n* = 86)	23 (26.7)	25 (29.1)	19 (33.7)	26 (66.3)	21 (24.4)	17 (19.8)	17 (19.8)	24 (27.9)

Table 2. Correlations between perfectionism, resilience, experience and psychological wellbeing, controlling gender and category (*n* = 583).

	Spanish Athletes				South American Athletes			
	Perfectionism		*Resilience*		*Perfectionism*		*Resilience*	
	PA	*PM*	*PC*	*A*	*PA*	*PM*	*PC*	*A*
Limitations of confinement	0.32	0.53 *	−0.49 *	−0.59 **	0.47	0.58 *	−0.50 *	−0.58 *
Sport experience	0.48 **	−0.52 *	0.62 **	0.63 **	0.53 **	−0.39 *	0.65 *	0.54 **
Psychological Well-being	0.13 **	−0.42 **	0.44 **	0.69 **	0.18 **	−0.63 **	0.53 **	0.63 **
Perfectionism Maladaptive	0.46 **	-	-	-	0.53 **	-	-	-
Personal Competence	0.57 **	−0.43 **	-	-	0.45 **	−0.54 **	-	-
Acceptance	0.39 *	−0.64 **	0.65 **	-	0.33 *	−0.59 **	0.61 **	-

* si $p < 0.05$; ** si $p < 0.01$; PA = Perfectionism Adaptive; PD = Perfectionism Maladaptive; PC = Personal Competence; A = Acceptance.

At the same time, in both the Spanish and South American samples, as confinement limitations increased, personal competence (<0.02–0.00) and acceptance (<0.03–0.00) scores worsened, while maladaptive perfectionism (<0.05–0.00) scores increased. Adaptive perfectionism showed no significant relationship in either the Spanish or the South American sample.

To verify the existence of perfectionistic, resilient resources and psychological well-being responses according to gender and category, multivariate contrast analyses were carried out (Table 3). In the sample of Spanish athletes, the results (Pillai's trace) indicate statistically significant differences in favour of U23 athletes who indicated higher levels of maladaptive perfectionism ($F_{(5,304)} = 7.23$; $p = 0.00$), while the senior athletes show a moderate magnitude effect ($\eta 2 = 0.52$; r = 0.58). In the same way, differences appeared in favour of women ($F_{(5,304)} = 10.26$; $p < 0.01$) against men, with a moderate size effect ($\eta 2 = 0.43$; r = 0.61). Gender* category interaction was significant ($F_{(5,304)} = 9.13$; $p = 0.00$) in maladaptive perfectionism, but not in adaptive perfectionism. For resilient resources, both personal competence ($F_{(5,304)} = 14.85$; $p = 0.00$; $\eta 2 = 0.39$; r = 0.47) and acceptance ($F_{(5,304)} = 16.03$; $p = 0.00$; $\eta 2 = 0.56$; r = 0.61) in male and senior athletes were significantly higher. Psychological well-being showed no significant differences in gender, but did show in category ($F_{(5,304)} = 21.24$; $p < 0.01$; $\eta 2 = 0.48$; r = 0.55). Gender*category interaction was significant for personal competence ($F_{(5,304)} = 14.21$; $p = 0.00$) and acceptance ($F_{(5,304)} = 6.91$; $p = 0.00$).

Table 3. Mean, standard deviations and multivariance analysis, according to gender and category.

	Spanish Sample (n = 309)					
	U23		Senior			
	Female (n = 28)	Male (n = 64)	Female (n = 105)	Male (n = 112)		
					$F_{(5,304)}$	$F_{(5,304)}$
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	Gender	Category
Adaptive Perfectionism	22.65 (1.10)	22.82 (1.73)	24.86 (0.89)	24.91 (0.35)	-	**
Maladaptive Perfectionism	25.29 (0.89)	25.28 (0.35)	23.45 (0.14)	23.31 (0.10)	-	**
Personal Competence	7.67 (0.14)	8.67 (0.41)	8.92 (0.16)	9.14 (1.20)	*	**
Acceptance	8.08 (0.19)	9.11 (0.38)	9.74 (0.15)	10.63 (0.22)	*	*
Psychological Well-being	22.87 (0.11)	22.25 (0.22)	24.11 (0.08)	23.94 (0.96)	-	**
	South American Sample (n = 274)					
	U23		Senior			
	Female (n = 22)	Male (n = 58)	Female (n = 92)	Male (n = 102)		
					$F_{(5,269)}$	$F_{(5,269)}$
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	Gender	Category
Adaptive Perfectionism	21.13 (0.85)	21.58 (0.91)	23.62 (0.52)	23.86 (0.68)	-	**
Maladaptive Perfectionism	24.04 (0.37)	24.36 (0.72)	23.51 (0.73)	24.47 (0.67)	-	-
Personal Competence	8.32 (0.68)	9.95 (0.25)	9.98 (0.67)	10.69 (1.32)	*	**
Acceptance	8.16 (0.34)	9.36 (0.52)	10.03 (0.48)	10.75 (0.46)	*	*
Psychological Well-being	21.34 (0.38)	23.04 (0.17)	21.87 (0.16)	23.24 (0.53)	-	**

* si $p < 0.01$; ** si $p < 0.001$.

In the sample of South American athletes, results (Pillai's trace) indicate statistically significant differences in favour of U23 athletes who indicated higher levels of maladaptive perfectionism ($F_{(5,269)} = 9.42$; $p = 0.00$), the opposite of the senior athletes, with moderate magnitude effect ($\eta 2 = 0.39$; $r = 0.51$). Similarly, differences appeared in favour of women ($F_{(5,269)} = 16.02$; $p = 0.00$) against men, with a moderate size effect ($\eta 2 = 0.57$; $r = 0.63$). Gender*category interaction was significant ($F_{(5,269)} = 15.36$; $p = 0.00$) in maladaptive perfectionism, but not in adaptive perfectionism. For resilient resources, both competence perception ($F_{(5,269)} = 13.37$; $p = 0.00$; $\eta 2 = 0.24$; $r = 0.53$) and acceptance ($F_{(5,269)} = 14.92$; $p = 0.00$; $\eta 2 = 0.43$; $r = 0.64$) in male and senior athletes were significantly higher. Psychological well-being showed no significant differences in either gender or category. Gender*category interaction was significant for personal competence ($F_{(5,269)} = 17.01$; $p = 0.00$) and acceptance ($F_{(5,269)} = 13.24$; $p = 0.00$).

4. Discussion

The present study aimed to describe the relationship and differences between perfectionism, resilient resources, and psychological well-being, according to several sociodemographic characteristics (category, gender, and practice of sport) during the confinement both in South American and Spanish athletes' cultural contexts being very affected by the COVID-19 pandemic.

Once it was verified that most of the participant athletes went through intense confinement (although those who did not suffer confinement did see their sports routines altered by the restrictions specific to each country (closure of facilities, difficult access to sports materials)), indicators of their psychological response focused on well-being were analysed, establishing linear relationships between perfectionism, resilient resources, and the psychological well-being of the athletes with different elements around their confinement situation. In this sense, it could be verified that those athletes who had more confinement increased their indicators of maladaptive perfectionism, and decreased their resilient resources. How-

ever, those with more experience managed their psychological response better by showing fewer indicators of maladaptive perfectionism and better adaptive perfectionism and resilient resources. Thus, and fulfilling the first of the hypotheses raised, as pointed out in the literature that explains the perfectionist functioning [4,6,41,42] and resilient responses in sports contexts [31,43], mainly in the first moments of any destabilizing situation, we should greatly value the sports experience for the development of adaptive resources (functional perfectionism and resilience) in athletes.

In the hope of showing similar results to studies linking them to psychological balance, those athletes who showed higher indicators of adaptive perfectionism (although poorly strong in the relationship) and resilient resources showed significantly higher well-being, while those who showed higher scores of maladaptive perfectionisms indicated lower psychological well-being. Galli & González [24] and other researchers, speak of the importance of resilience for the appearance of positive elements for maintenance in sports practice like commitment [42], self-confidence [43], sociocultural influences [44] coping strategies [16,45], motivation [28] or own well-being [46]. Hill et al. [40] showed in an excellent meta-analytical study that perfectionist concerns show an obvious maladaptive function for athletes, while perfectionist efforts are complex and ambiguous in the first instance, not achieving enough to find a suitable psychological balance. Muñoz-Villena et al. [47] showed in a sample of young people in high-performance sports academies that the main differences between those who showed low and high self-esteem were in the definition of their standards and in the process of orienting themselves to their achievement, while Gaudreau & Verner-Filion [48] found that self-directed perfectionism (setting realistic goals and efforts, and designing a path of coherence) is associated with high levels of positive affection and vitality, as well as greater satisfaction with life than non-perfectionists.

In terms of differences between gender and category, the results agree with the hypotheses. While the more traditional literature on perfectionism in sport describes a broad consensus on the low relevance of gender, the category (more age and sports experience) has been described as important because it shows less perfectionism the higher the sport category [49]. Senior athletes find more positive associations between more adaptive perfectionism and positive affect, and between more maladaptive perfectionism and negative affect, both in favour of the male gender [41].

According to the hypothesis in terms of resilience resources, both personal competition and acceptance are higher for men and top-level athletes. It seems that the confinement situation created by COVID-19 did not change the results obtained in the baseline studies on the influence of gender and category on resilience. Fletcher & Sarkar [21] considered resilience as a construction that is developed and acquired based on personal progress, because of social, psychological, external and internal processes, aspects that are most evident in Olympic athletes who have experienced greater variability in sporting experiences. Bicalho et al. [43] mention that sports resilience is the continuous interaction of individual psychological characteristics and the environment that an athlete may have. On the other hand, Lipowski et al. [50] and González-Hernández et al. [51], in studies with young people, point out that sport practice enhances resilience indicators, as well as being a more protective factor for women than for men. Similarly, it is clear that for both female and U_{23} athletes, higher indicators of maladaptive perfectionism are obtained (greater rigidity of thought, greater concern and self-criticism) similarly with studies conducted with general samples of athletes before the confinement.

Psychological well-being is more significant for senior athletes, with no relevant differences according to gender. While it is understood that more experienced athletes have greater maturity and understanding of life circumstances, younger athletes have been more hopeless about the limitations of confinement. All of this is in line with the hypotheses in studies on psychological well-being among athletes of different ages [16] and sporting experience [52]. Although most of the hypotheses have been confirmed, recent studies have marked the relevance of sports practice for psychological well-being in terms of gender, in

favour of men [53], it should be noted that no gender differences have been found between the scores of men and women in this study, although they have shown high indicators of psychological well-being in both subgroups. However, like all the results obtained, the situations created by the COVID-19 confinement should be taken into consideration.

Finally, as expected, given that the situations created by the confinement of COVID-19 have been very similar in both contexts, the results indicate similar results in the Spanish and South American samples.

Although such a study with a large sample size indicates significant differences in athlete samples, it is necessary to point out certain limitations and difficulties in data collection and difficulties in methodological design due to confinement situations. The contact with athletes in this situation has generated a high cost in effort and time of researchers, and data have required a more intense statistical treatment to confirm the validity of the content, and the analysis should be limited to the circumstances generated by COVID-19.

Nevertheless, and for almost the same reasons, due to the similarity of the results obtained, it is evident that the COVID-19 confinement situations had not changed the relations between relevant variables for the psychological response of the athletes. This shows that although many of them have suffered inevitable changes, the study is well planned and carried out, consolidating similar proposals without any alteration for scientific continuity. It would be ideal to contrast these data with the appearance of longitudinal proposals, which would allow us to observe whether such psychological responses would be altered in the long term if the pandemic and the circumstances of confinement persist.

5. Conclusions

Athletes are immune to discouragement. Accustomed to suffering, they can look at difficult challenges, facing them and overcoming them by showing superior competences than general population. Undoubtedly, societies are giving them examples to follow in the face of adversity, and in the face of so many limiting circumstances generated by the confinement of the COVID-19 pandemic, they continue to show their usual, functionalised responses to continue their performance and adapt to any change.

While the younger ones will show their usual excess of ambition, the more experienced athletes show greater resources for understanding situations. Most competitive situations had been cancelled (national and international championships, Olympic Games), most of their usual sports dynamics had disappeared or been altered (e.g., training places and facilities, times for travel and sports preparation, contact with colleagues, coaches and rivals), and yet they found new ways to continue with their responsibilities.

Regardless of their gender, it seems that sports maturity made the main difference when it comes to showing both rigidity in perfectionist patterns (both adaptive and maladaptive) and in responding to adversity. Although age, dynamism and variability of the experiences lived by athletes are very relevant factors in the trajectory of an athlete, they continue to represent a degree of balance in front of difficulties of COVID-19.

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Relationships among Sports Group Cohesion, Psychological Collectivism, Mental Toughness and Athlete Engagement in Chinese Team Sports Athletes

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Abstract: Background: Cohesion is an important factor affecting sports performance. This study constructed a mediating model to explore the mechanism of cohesion toward psychological collectivism, mental toughness, and athlete engagement of Chinese team sports athletes, and to investigate the mediating effect of psychological collectivism and mental toughness on cohesion and athlete engagement. Methods: A total of 326 active Chinese athletes (54% males, 46% females) aged 14 to 26 years (M = 19.63, SD = 6.51) from eight sports were investigated by questionnaire. Results: The athlete engagement can be predicted significantly and positively by cohesion and its dimensions, and ATG-T is more important in advantage analysis. Direct and indirect paths indicate that cohesion affects athlete engagement, through the mediating effects of psychological collectivism, the mediating effects of mental toughness, the serial multiple mediating of psychological collectivism and mental toughness. The mediating effect model had a satisfactory goodness of fit and explained 50.5% of the variance in athlete engagement, and the SEM revealed the mechanism of cohesion in Chinese athlete engagement to a certain extent. Conclusion: Psychological collectivism is the embodiment of high-quality cohesion in Chinese team sports. The increase in cohesion and psychological collectivism can improve Chinese athletes' ability to cope with stressful situations in sports, which may allow them to achieve a better performance through athlete engagement.

Keywords: psychological collectivism; cohesion; athlete engagement; mental toughness

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1. Introduction

For many sporting experiences, athletes are members of groups or teams. These groups have a strong effect on the members of the group. Cohesion is one of the most important small group variables that is derived from the evolution of group culture [1]. Although previous studies have shown that group cohesion can improve athletes' sports performance [2,3], a lack of discussion on the mechanism and conditions between the two was observed because objective performance is affected by many factors [4]. In addition, in a large sample survey, the competition results of various events are also difficult to integrate into a unified scale. Therefore, measuring the psychological variables that reflect the sports performance at the individual level has become an efficient strategy for cohesion research. The purpose of this study was to investigate the relationships among cohesion psychological collectivism, mental toughness, and athlete engagement, in addition to gaining an in-depth understanding of the relationship between cohesion and sports performance from a positive psychology perspective.

2. Theoretical Background and Hypotheses

Cohesion is one of the most important small group variables, which reflects the integration and coordination level of the group and is an important internal factor affecting the realization of the goal [1]. Cohesion is an important source of the athletes' social support [1], but it is also positively associated with a variety of group and individual

outcomes, which comprise team performance, effectiveness, confidence, positive affect, and exercise adherence [2–4]. The generally accepted definition is that cohesion is a dynamic process that is reflected in the tendency of a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs [1]. Cohesion should be divided into at least two aspects: task cohesion, which is related to the commitment of team objectives and achievement indicators; and social cohesion, which involves more interpersonal relationships, such as friendship and emotional support [1].

The relevant results of team cohesion have provided a good theoretical basis for studying sports team cohesion. The analysis of the relationship between sports team cohesion and sports performance is based on the basic analysis framework of team cohesion [2]. After Carron and others defined the operational definition of cohesion, four dimensions were formed: individual attractions to the group—task (ATG-T), individual attractions to the group—social (ATG-S), group integration—task (GI-T), and group integration—social (GI-S), which were quickly applied to the research of sports team cohesion and achieved a large number of relevant results [1,4].

The relationship between cohesion and sports performance has always been the focus of attention [2,4,5]. However, research shows that the actual situation is much more complex. The sports involved in the research of positive correlation between cohesion and sports performance are mainly collective events, such as basketball, volleyball, and hockey [4,5], whereas a small number of sports involved in the research of a negative correlation or no correlation are individual events, such as bowling and shooting [4,5]. Because of the complexity itself and our the limitation of our understanding, a lack of discussion about the mechanism and conditions between cohesion and sports performance was observed.

Recent studies have identified the positive effects of cohesion on engagement in many fields and environments, such as employment [6], classroom [7], community [8], and army [9]. Relevant studies mostly take engagement as the observation index of the work performance of the organization members. In organizational behavior research, engagement refers to the situation in which the organization members are in a lasting and perfect state full of positive emotions and motivation [10]. Lonsdale (2006) introduced the concept into the field of sports, and determined that athlete engagement is the perfect link connecting individual characteristics, sports factors, and sports performance [11]; compared with sensory indicators such as sports satisfaction, athlete engagement can intuitively reflect the positive experience of individual cognition, and behavior, self-confidence, dedication, vigor, and enthusiasm are its main characteristics [11]. The influencing factors of athlete engagement comprise internal factors such as basic psychological needs, gratitude, mental toughness, and coping style, in addition to external factors such as the coach–athlete relationship, motivation atmosphere, and social support. Zhang (2011) believes that athlete engagement is an important indicator of the athletes' positive psychology, and can reflect the athletes' positive and healthy psychological state, which is conducive to stimulating the athletes' positive qualities, such as optimism, resilience, sense of significance, and creativity, to promote the development and sophistication of athletes, in addition to laying a solid foundation for enhancing their sports ability and improving their sports performance. Therefore, athlete engagement may be used as an alternative index of sports performance to appropriately reflect the mechanism of cohesion in individual sports performance.

At present, the research on the influencing factors and mechanism of athlete engagement is limited. By looking at the variables for this study, cohesion is considered within the motivation atmosphere and social support. One study found that team cohesion was positively related to organizational identity and work engagement [12]. As a special organizational identity, psychological collectivism may be consistent with the perspective of this study and fit under the basic psychological needs and gratitude factors for the athlete engagement.

Recent studies have found young athletes who are closely related to their own sports teams can perceive more cohesion [13], which seems to be promoted by the existence of

collective-oriented team members [14,15]. In organizational behavior, a large number of studies cited collectivism as an important feature of a cohesive group [16]. Historically, collectivism has mostly been constructed as a cultural variable, representing the overall model in a complex society [17,18]. This approach is mainly due to Hofstede's (1980) cross-cultural research, which identified a range of differences focusing on the value system related to national work. However, this perspective operates collectivism as a social preference by using the national average score, which cannot accurately explain or attempt to explain individual behavior. In recent years, scholars have constantly proposed different views and advocated that collectivism should be regarded as an individual difference variable in the team environment [19]; that is, the analysis from the culture to the personality. This specific perspective is considered to accurately reflect the collectivist tendency in the individual's basic psychological process [20], which is also known as psychological collectivism.

Psychological collectivism refers to individuals who regard themselves as members of one or more groups, who are mainly inspired by the norms of members of the group, give priority to the goals and well-being of members of the group, and emphasize their connection with members of other groups [20]. From this perspective, Jackson et al. developed a corresponding questionnaire that comprises preference, reliance, concern, acceptance, and goal priority [20]. The measurement demonstrates that psychological collectivism is closely related to several important personal variables of staff in the team environment, such as member dependence, emotional, information and evaluation support, effective team operation behavior, and citizenship behavior [21–23]. In addition, the harmony and cohesion of the group may affect the individual emotion in a high level of psychological collectivism [22]. Recently, this relevance has also been recognized in elite sports situations [24]. Considering the link between collectivism and supportive team behavior, athletes participating in these environments should experience more social support and obtain subsequent persistence behavior.

Competitive sports events are full of pressure and challenges. The athlete engagement promoted by cohesion and psychological collectivism aims not to eliminate the existence of negative mentality in competitive sports events, but to ensure the targeted engagement of athletes by improving individual toughness. Mental toughness is the quality that reflects the athletes' self-confidence, focus, and motivation in stressful situations; it refers to a psychological advantage inherited or developed after birth [25], and self-confidence, control, and constancy are its main characteristics [26]. Research has found that athletes with high mental toughness have high control beliefs about stress situations, tend to evaluate stresses as challenges rather than threats, have high coping self-efficacy, and adopt more problem-focused coping strategies [26]. Athletes with this advantage may be better able to deal with the pressure in competition, training, and life than their competitors, be more firm, focused, and confident in a pressure situation, and maintain self-control, to perform better than their competitors [27]. Therefore, mental toughness significantly improves the individual's sports state, wherein athletes rarely experience the psychological and physiological discomfort that limits the exertion of personal ability [25]. In addition to the protective effect in stress situations, the study found that mental toughness also has obvious advantages. For example, it can enhance the athletes' optimism, flow experience, and self-determination motivation, and improve competition results [25–27]. Gucciardi et al. [28] found through qualitative research that athletes with high mental toughness will not only have greater individual positive cognition, but also devote themselves to training and competition with positive attitudes, such as task focus, active self-discipline, and perseverance. In addition, Wang (2014) found that mental toughness significantly negatively predicts athletes' burnout, whereas athlete engagement, as the opposite of burnout, may be positively affected by mental toughness.

In terms of the literature review, we found that the development of mental toughness involves several unique mechanisms that operate together over a long period of time and through unique developmental stages [25]. In addition to psychological skills and strategies,

features relating to the motivational climate, external assets (i.e., coaches, peers, parents, senior athletes, sport psychologists, team-mates) [26–29], and both sport and non-sport related developmental experiences were discussed as the most important mechanisms. Jones (2006) summarized a mental toughness theory and divided the process of mental toughness into three stages: mental toughness behavior is controlled by mental toughness thinking, and mental toughness thinking is influenced by environment and personality. By looking at the variables of this study, cohesion and psychological collectivism falls under the mental toughness environment, including the motivation climate and external assets, whereas athlete engagement can fit under mental toughness behavior. Similar findings revealed that cohesion can significantly affect the formation of mental toughness with a sport-specific sample of college athletes [26].

Based on the above discussion, cohesion, psychological collectivism, mental toughness, and athlete engagement indicate that many different constructs and relationships warrant further examination. First, athlete engagement can be used as an alternative index of sports performance to reflect the psychological mechanism of cohesion affecting sports performance. Second, many studies cited collectivism as an important feature of a cohesive group. However, there is a lack of empirical research. This study attempts to demonstrate the relationship between sports group cohesion and psychological collectivism, and the impact of psychological collectivism on sports performance/athlete engagement. Third, there are mediating factors in the influence of cohesion and psychological collectivism on athlete engagement, which need the help of stress resistance ability. Based on the above, these research hypotheses are proposed:

Hypothesis 1 (H1). *Cohesion and its constructs are positively related to athlete engagement.*

Hypothesis 2 (H2). *Psychological collectivism mediates the relationship between cohesion and athlete engagement.*

Hypothesis 3 (H3). *Mental toughness mediates the relationship between cohesion and athlete engagement.*

Hypothesis 4 (H4). *Psychological collectivism and mental toughness sequentially mediate the relationship between cohesion and athlete engagement.*

3. Methods

3.1. Recruitment and Participants

The participants were professional athletes and high-level college athletes selected from the national training team and Zhejiang, Heilongjiang, Liaoning, and other provinces and cities in China. All of them are team sports athletes having at least three years of sports training experience. Considering that n = 200 is the minimum sample size for SEM [30], a total of 445 athletes were investigated by questionnaire in this study, after deleting questionnaires with an overly short response time (less than three min) and those with answers that tend to be consistent, 326 were effectively recovered, with an overall effective rate of 73.3%.

3.2. Instruments

The questionnaire comprised three parts. First, we stated that this survey was being conducted voluntarily and anonymously. The answers to the questionnaire were only available for the researchers and not for commercial or any other use. Second, collection of the athletes' basic information. Third, the scale of the questionnaire used in this study. All questionnaire responses involved in this study were scored in five-point Likert scales, from strongly disagree (1) to strongly agree (5); the higher the score, the higher the recognition and acceptance of the item. The details are as follows:

3.2.1. Group Environment Questionnaire (GEQ)

The GEQ compiled by Carron (2010) and translated by Ma Hongyu [31] was adopted. This questionnaire is a special measurement questionnaire for sports cohesion, which has good reliability and validity in Chinese use. There are 15 items in the questionnaire, including four dimensions, ATG-T, ATG-S, GI-T and GI-S, that respectively represent the two levels of integration and involvement of task cohesion and social cohesion. In this study, the total amount and each dimension's Cronbach's α is 0.71~0.87.

3.2.2. Psychological Collectivism Questionnaire (PCQ)

The PCQ compiled by Jackson (2006) and translated by Zhang Lan [32] was adopted. This questionnaire has passed many research tests in China, and has a total of 15 items, including five dimensions: preference, reliance, concern, acceptance, and goal priority. According to the purpose of the study, this questionnaire describes and supplements the content of sports situations. For example: "I can accept the rules and regulations of the team" $\rightarrow$ "I can accept the rules and regulations of the sports team", "compared with my personal work goal, the team task goal is more important" $\rightarrow$ "compared with my personal sports goal, the team sports goal is more important", etc. In this study, the total amount and each dimension's Cronbach's α is 0.74~0.91.

3.2.3. Sports Mental Toughness Questionnaire (SMTQ)

The SMTQ was compiled by Sheard et al. (2009) and translated by Wang Bin et al. There are 12 items in total, including three dimensions of self-confidence, constancy, and control. In this study, the total amount and each dimension's Cronbach's α is 0.71~0.82.

3.2.4. Athlete Engagement Questionnaire (AEQ)

The AEQ was compiled by Lonsdal et al. (2007) and revised by Ye Lv's translation [33]; there are 16 items, including four dimensions of self-confidence, dedication, vigor, and enthusiasm. In this study, the total amount and each dimension's Cronbach's α is 0.90~0.95.

3.3. Data Collection

Paper-and-pencil self-administered questionnaires were distributed to athletes after the end of training. To ensure the quality of responses, the research assistants read the instructions and explained the purposes and requirements of the questionnaire at the beginning. Completion of the survey took an average of seven minutes.

3.4. Validity and Reliability of the Instrument

The reliability and validity of the measurement scale were subsequently evaluated. Confirmatory factor analysis (CFA) was used to establish the internal validity of each construct. CFA showed that the modified model fit the data well: CMIN/DF = 3.68, RMSEA = 0.06, GFI = 0.91, NFI = 0.92, CFI = 0.94. Then, the internal consistency reliability and composite reliability (CR) were evaluated (shown in Table 1). The Cronbach's α values of each construct were all above 0.7, thus indicating an acceptable reliability [30]. Moreover, the CR value of each construct surpassed 0.7, thus showing good composite reliability [30]. Regarding the convergent validity, it can be evaluated by average variance-extracted (AVE) and factor loadings (FL). The values of AVE and FL of each construct were higher than 0.4, thus indicating an acceptable level of convergent validity (see Table 1) [30].

Table 1. Reliability and validity analysis.

Variables	Variables	Items	Cronbach's α	CR	AVE	FL
Cohesion	ATG-T	3	0.77	0.79	0.56	0.72–0.80
	ATG-S	4	0.83	0.84	0.56	0.71–0.79
	GI-T	4	0.77	0.71	0.51	0.49–0.81
	GI-S	3	0.71	0.70	0.44	0.40–0.50
Psychological Collectivism	preference	3	0.90	0.78	0.58	0.56–0.74
	reliance	3	0.78	0.88	0.64	0.68–0.90
	concern	3	0.74	0.76	0.59	0.65–0.78
	acceptance	3	0.77	0.86	0.64	0.69–0.86
Mental Toughness	goal priority	3	0.90	0.91	0.71	0.75–0.88
	self-confidence	4	0.73	0.70	0.50	0.43–0.66
	constancy	4	0.75	0.77	0.54	0.60–0.67
	control	4	0.71	0.74	0.51	0.65–0.98
Athlete Engagement	self-confidence	4	0.90	0.90	0.69	0.78–0.86
	dedication	4	0.90	0.90	0.69	0.76–0.88
	vigor	4	0.91	0.91	0.71	0.78–0.89
	enthusiasm	4	0.92	0.92	0.75	0.83–0.91

3.5. Common Method Bias

The data for all constructs were collected simultaneously through a self-reporting questionnaire; thus, the common method bias (CMB) was a potential problem. To reduce the interference of common method bias on validity, this study applied a balanced item order, anonymous questionnaire measurement, and standardized measurement in the process of the questionnaire. CMB can be tested by Harman's one-factor test and the CFA marker variable approach [30]. Results show that the variance explained by the first factor of principal component analysis was 35.23%, which was less than the critical standard of 40%. Confirmatory factor analysis found that the fitting index of the 16-factor model (χ^2 = 180.51, χ^2/df = 3.68, RMSEA = 0.06, CFI = 0.94, GFI = 0.91, NFI = 0.92) is significantly better than the single-factor model (χ^2 = 531.53, χ^2/df = 10.52, RMSEA = 0.12, CFI = 0.55, GFI = 0.53, NFI = 0.52).

3.6. Data Analysis

SPSS 22.0 (IBM, Armonk, NY, USA) was used to input the questionnaire data for descriptive analysis, reliability analysis, and hierarchical regression analysis; AMOS 21.0 (IBM, Chicago, IL, USA) was used for a common method deviation test, confirmatory factor analysis, and mediation effect model analysis.

4. Results

4.1. Descriptive Analysis

A total of 445 questionnaires were distributed from 1 June to 1 October 2020. After deleting questionnaires with an overly short response time (less than three min) and those with answers that tended to be consistent, 326 were effectively recovered, with an overall effective rate of 73.3%. Among them, 175 were male (53.7%) and 151 were female (46.3%); there were 72 state second-class athletes (22.1%), 127 state first-class athletes (40.0%), 76 state elite athletes (23.3%), and 52 people who lacked sports class information. The average age of athletes was 19.63 years (SD = 6.51), and the average training period was 6.78 years (SD = 3.37). Sports comprised basketball (74), volleyball (36), football (63), cricket (47), ice hockey (20), curling (11), group aerobics (47), and others (28).

4.2. Correlational Analysis

Table 2 illustrates the mean (M) and standard deviations (SD) of cohesion, psychological collectivism, mental toughness, and athlete engagement, and Spearman analysis was used to examine the correlation coefficients among cohesion, psychological collectivism, mental toughness, and athlete engagement. Results show that all variables are significantly

correlated, and the correlation coefficient ranged from 0.35 to 0.67, thus supporting the effectiveness of the overall data of the measurement model and the rationality of the topic packaging strategy.

Table 2. Descriptive statistics of model variables and correlations among model variables.

Component	M	SD	1	2	3	4
Cohesion	4.06	0.52	–			
Psychological Collectivism	3.97	0.63	0.64 ***	–		
Mental Toughness	3.36	0.32	0.35 ***	0.49 ***	–	
Athlete Engagement	4.04	0.63	0.62 ***	0.67 ***	0.43 ***	–

Note: *** $p < 0.001$.

4.3. Analysis of the Advantages of Different Dimensions of Cohesion in Predicting Athlete Engagement

After controlling for the gender, age, training years, and sports grade, cohesion can explain 28% of the variation of athlete engagement alone by using a hierarchical regression analysis ($\beta = 0.62$, $t = 7.08$, $p < 0.001$). However, the potency of various dimensions of cohesion on athlete engagement is unclear. To clarify the interpretation effect of relevant dimensions, the advantage analysis method with model independence was used to calculate the change value of R^2 after each explanatory variable was added to the sub-model without the variable itself, to explain the relative contribution of each dimension of cohesion to the effect of athlete engagement. Results show that (Table 3) all dimensions of cohesion are significantly and positively correlated with athlete engagement, and H1 is verified; among them, ATG-T (40.3%) contributed the most to the explained variation.

Table 3. Cohesion constructs predicting relative contribution of athlete engagement.

Multidimensional Dimension of Cohesion	R^2	Value-Added Contribution			
		X_1	X_2	X_3	X_4
—	—	0.352	0.374	0.081	0.333
X_1	0.352	—	0.041	0.010	0.049
X_2	0.374	0.019	—	0.010	0.046
X_3	0.081	0.281	0.303	—	0.260
X_4	0.333	0.068	0.087	—	0.008
X_1X_2	0.393	—	—	0.007	0.033
X_1X_3	0.362	—	0.038	—	0.043
X_1X_4	0.401	—	0.015	0.004	—
X_2X_3	0.384	0.016	—	—	0.040
X_2X_4	0.420	0.006	—	0.004	—
X_3X_4	0.341	0.064	0.083	—	—
$X_1X_2X_3$	0.400	—	—	—	0.029
$X_1X_2X_4$	0.426	—	—	0.003	—
$X_1X_3X_4$	0.405	—	0.024	—	—
$X_2X_3X_4$	0.424	0.005	—	—	—
$X_1X_2X_3X_4$	0.429	—	—	—	—
Relative importance analysis	—	0.079	0.173	0.034	0.142
Predicted variance percentage	—	18.41	40.33	7.93	33.10

Note: X1, X2, X3, X4 indicate ATG-T, ATG-S, GI-T, GI-S.

4.4. Mediating Effect of Psychological Collectivism and Mental Toughness in Cohesion and Athlete Engagement

In the mediating effect model (Figure 1), cohesion significantly predicted psychological collectivism (PC) ($\beta = 0.76$, $p < 0.01$) and psychological collectivism significantly predicted athlete engagement (AE) ($\beta = 0.69$, $p < 0.01$), indicating that an indirect effect exists on the

path of psychological collectivism in cohesion and athlete engagement, and the effect value is 0.76 × 0.69 = 0.52; thus, H2 is verified.

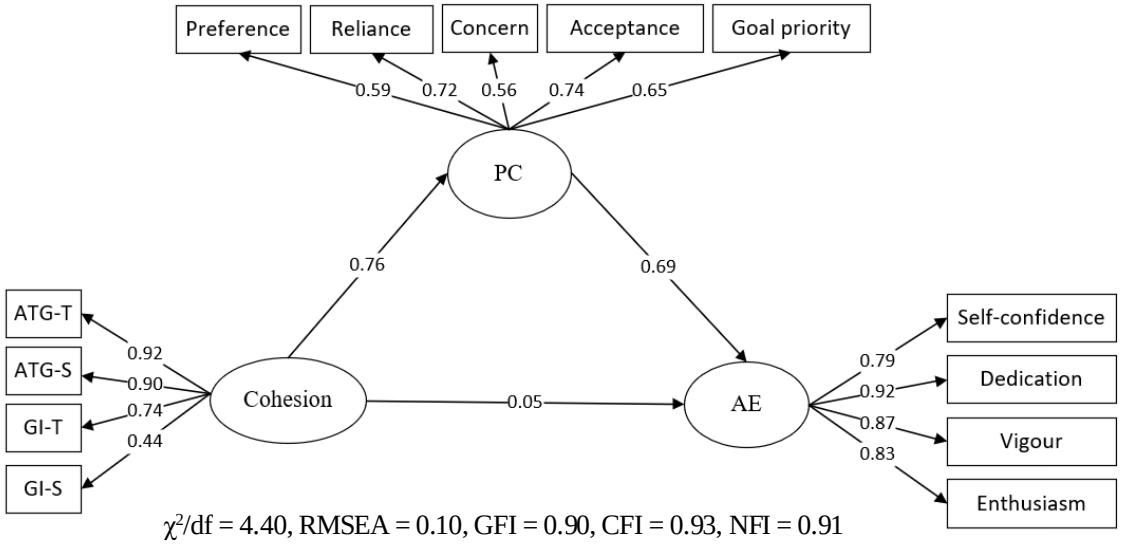

Figure 1. Mediating role of psychological collectivism.

In the mediating effect model (Figure 2), cohesion significantly predicts mental toughness (MT) ($\beta = 0.45$, $p < 0.01$) and mental toughness significantly predicted athlete engagement ($\beta = 0.39$, $p < 0.01$), indicating that there is an indirect effect on the path of mental toughness in cohesion and athlete engagement, and the effect value is 0.45 × 0.39 = 0.18; thus, H3 is verified.

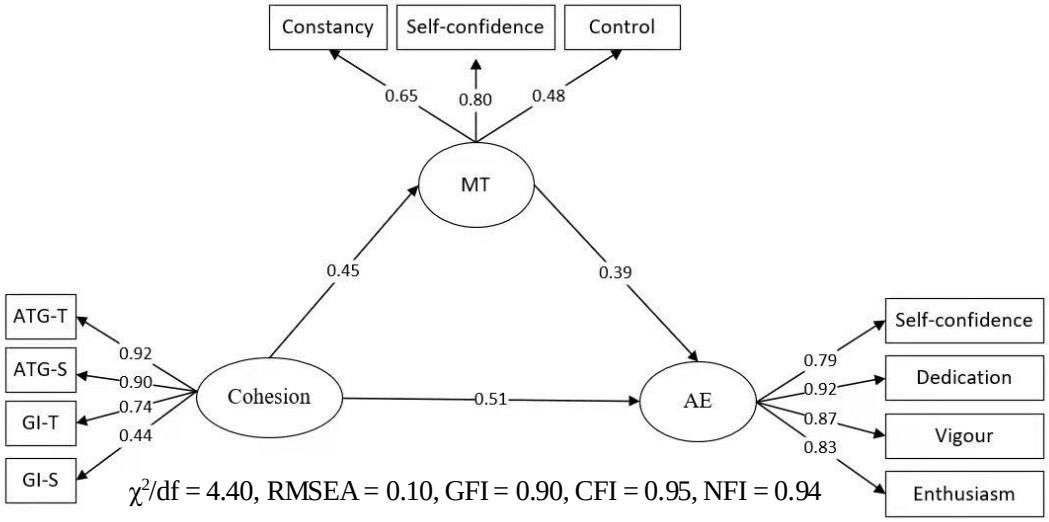

Figure 2. Mediating role of mental toughness.

In the sequential mediating effect model (Figure 3 and Table 4), cohesion significantly predicted psychological collectivism ($\beta = 0.69$, $p < 0.01$), mental toughness ($\beta = 0.16$, $p < 0.01$), and athlete engagement ($\beta = 0.10$, $p < 0.01$); psychological collectivism significantly predicted mental toughness ($\beta = 0.73$, $p < 0.01$) and athlete engagement ($\beta = 0.19$, $p < 0.01$); mental toughness significantly predicted athlete engagement ($\beta = 0.70$, $p < 0.01$), indicating that an indirect effect exists on the path of psychological collectivism in cohesion and athlete engagement, an indirect effect exists on the path of mental toughness in cohesion and athlete engagement, and an indirect effect exists on the path of psychological collectivism and mental toughness in cohesion and athlete engagement, and its effect value

is 0.69 × 0.73 × 0.70 = 0.35; thus, H4 is verified. Among them, the total indirect effect of psychological collectivism and mental toughness accounted for 85.5%, which shows that the intermediary effect is greater than the direct effect in the effect of cohesion on athlete engagement. Through the model fit's R^2 calculation, cohesion, psychological collectivism, and mental toughness explained 50.5% of the variation in athlete engagement.

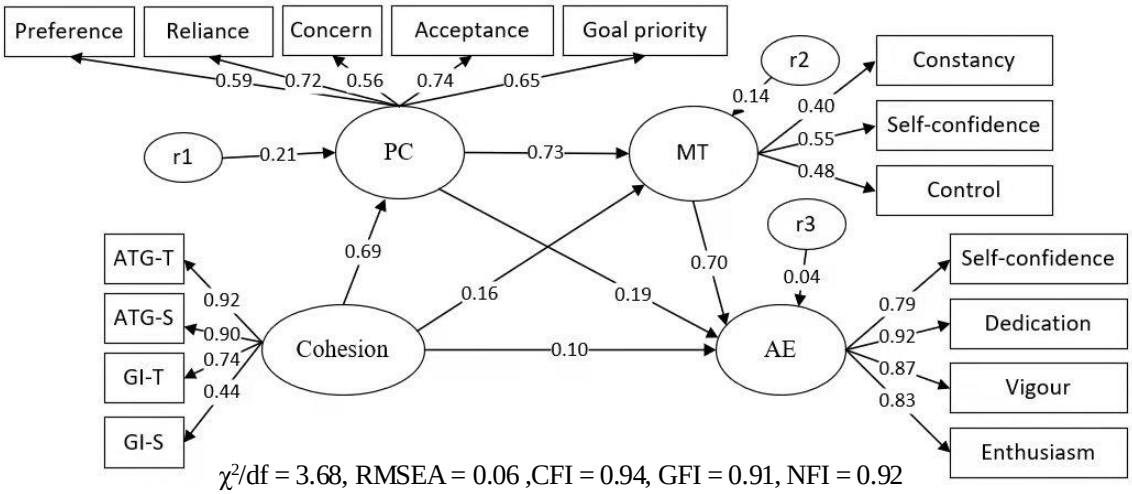

Figure 3. Mediating role of psychological collectivism and athlete engagement.

Table 4. Effect analysis of latent variables.

Influence Path	Standardized Effect Value	Significance	%
Cohesion→Athlete Engagement	0.10	***	14.5
Cohesion→Psychological Collectivism →Athlete Engagement	0.69 × 0.19 = 0.13	***	18.8
Cohesion→Mental Toughness→Athlete Engagement	0.16 × 0.70 = 0.11	***	15.9
Cohesion→Psychological Collectivism→Mental Toughness→Athlete Engagement	0.69 × 0.73 × 0.70 = 0.35	***	50.7
The total indirect effect	0.13 + 0.11 + 0.35 = 0.59	***	85.5
The total effect	0.59 + 0.10 = 0.69	***	— —

Note: *** $p < 0.001$.

5. Discussion

5.1. Direct Effect of Cohesion on Athlete Engagement

This study found that there was a significant positive correlation between cohesion and athlete engagement, and cohesion can also independently and significantly predict athlete engagement in regression model. This result shows that, in the field of competitive sports, cohesion as an important external resource that can significantly improve the athletes' engagement and promote them to devote themselves to sports with full enthusiasm, vitality, and great self-confidence. In sports, cohesion is an important source of social support for athletes [2]. When athletes have more social support, they experience a higher sense of belonging and security, and be able to obtain effective suggestions and guidance from others to improve their sport skills, so as to improve their competence and self-confidence. Thus, a good cohesive environment undoubtedly plays a significant role in promoting the satisfaction of basic psychological needs, the stimulation of internal motivation, and the improvement of engagement.

Carron (2010) indicated that the development of sports cohesion includes three conditions: first, the group goal is clear and is recognized by members. Second, the needs, motives, and emotions among members are fully understood and supported. Third, those with prestige form the backbone, which plays the role of regulating and communicating interpersonal relations, decision making, organization, and leadership. When these con-

ditions are established, the team can produce the energy amplification effect of mutual encouragement and improving behavior efficiency, while achieving the self-defense effect of mutual protection of external pressure [1–5]. These gain effects can stimulate the athletes' self-determination motivation [34], and continue to influence members to promote them to maintain an outstanding state and unyielding personality performance.

In previous studies, inconsistent research results have been observed regarding the relationship between cohesion and sports performance. Ma Hongyu (2002) and others believe that this is related to the individual/collective sports of cohesion and the goal setting of the group [4]. Considering these effects, this study selected team sports athletes as subjects. Through the advantage analysis, the four dimensions of cohesion can significantly and positively predict athlete engagement and play their own unique roles. According to the demand resource model theory, the autonomy task goal and social support can inhibit fatigue and improve the members' engagement [35]. In addition, the results may also be related to the cultural values of Chinese athletes. Some Chinese scholars believe that Chinese athletes have stronger feelings of family and country, sense of responsibility, and relationship needs [36]. They are more likely to project the purpose, tasks, and principles of group activities onto the standards of individual behavior, and automatically adjust and adapt to the behavior norms determined by these indicators [36]. The advantage analysis also shows that, compared with the other dimensions, ATG-T is an important factor affecting athlete engagement. This is similar to the previous results on the relationship between cohesion and sports performance.

5.2. The Intermediary Role of Psychological Collectivism and Mental Toughness between Cohesion and Athlete Engagement

In addition to the direct effect, cohesion can also affect athlete engagement through three indirect paths:

Cohesion has a positive effect on athlete engagement through psychological collectivism. This result shows that psychological collectivism is not only an important embodiment of a cohesive group, but also a psychological process in which cohesion promotes the performance of team sports. Strong and stable cohesion can not only enhance group control and urge members to exert every effort to achieve their goals, but also help to strengthen the belief of group members to win and enhance cooperation [1]. According to the self-classification theory [37,38], the improvement in the saliency of internal and external group classification may enhance the consistency and similarity between self and internal group members, and eventually leads to the change in many social identity effects of individual perception. This is similar to the preference for internal groups, the exclusion of external groups, the stereotyped perception of internal and external groups, and ethnocentrism. In the field of sports, athletes will anchor sports goals, follow common norms, and seek internal identity according to the overlapping interpersonal boundaries, involved group roles, and similar situational perception characteristics. When the needs of dependent and belonging groups occupy a greater weight in sports decision making, the members' thinking will tend to the collective nature and characteristics of consistency and similarity, while the actual effect of these results will support individuals to produce values and emotional experiences conducive to the needs of team operation in group activities.

Petrovsky, a former Soviet social psychologist, paid attention to the phenomenon of collectivism in sports. He believed that the sports team is a cooperative group. The relationship between individuals depends on the success or failure of common activities. This group activity itself is the projection of social goals, tasks, and principles [39], reflecting the social consensus formed under the influence of inter group relations. For example, the research results of baseball and football in Japan support the promotion of collectivism culture on competitive sports performance [40]. As an Asian country deeply influenced by Confucian culture, these results in Japan are not surprising. However, PCQ's research in the field of sports found that American youth athletes also tend to be collectivist in terms of coordination among members [10]. In addition, social identity theory expresses

the importance of group influence and process in individual behavior. It believes that individuals define themselves according to their group, while identifying valuable groups can enhance self-esteem and self-concept; at the same time, abiding by group norms is of great significance for individuals to obtain group recognition [41,42]. Brewer (2015) [43] defined it as "the extent to which the in-group has been incorporated into the sense of self, and at the same time, that the self is experienced as an integral part of the in-group", which is particularly important for a successful sports performance. Recent studies have found that athletes who have a strong perception of the interdependence between results and teammates may also have a stronger sense of social identity for their team [42]. Considering the support for belonging needs, this social identity may further affect the emotion and behavior of team sports members, and lead to a tendency to collectivize. Some studies on personality psychology believe that collective-oriented individuals tend to provide more emotional, information, and evaluation support to others, and to show higher teamwork behavior [20]. These individuals establish their identity on the basis of group members and attribute great value to interdependence, which is common in countries with collectivism as cultural characteristics [23], because collectivism-oriented culture focuses on people's interdependence, social embeddedness, and obligations and loyalty to internal groups (such as families). Team sports may provide an ideal environment for collective-oriented individuals to meet their desire for collectivity.

Thus, psychological collectivism is the embodiment of high-quality cohesion. The psychological collectivism in team sports is not only affected by the social and cultural background on personality, but also includes the community phenomenon of emotional psychology in small group problems. When the desire to belong to the group occupies a greater weight in sports decision making, psychological collectivism will support individuals to produce emotion and engagement.

Cohesion has a positive effect on athlete engagement through mental toughness. Under the influence of primary groups and someone prestigious, the tolerance of a single person to the current situation can be increased from 21% to 57% [39]. Zhang (2000) believes that athletes in the group environment can be affected by the emotional infection and behavior of other members of the group at any time, and everyone will conform, obey, or depersonalize under the action of special normative factors of the group [5]. Cohesion can not only help the individual members rebound from the pressure to mentality achieve reorganization, but it also can amplify energy and drive the individual members to make continuous efforts toward their peak playing condition. It helps individual members to draw more information, emotion, and instrumental support from the team [44]. These resources help athletes fulfill their sports needs, slow down the setting of self-obstacles, and reduce the potential negative feedback, to activate the athletes' positive and lasting emotional cognition and obtain athlete engagement.

Cohesion plays a positive role in athlete engagement through psychological collectivism and mental toughness. This study indicates that, in team sports, psychological collectivism is a psychological tendency influenced by the collective environment (cohesion). Under this tendency (psychological collectivism), athletes will improve their mental ability (mental toughness) and then affect their sports performance (athlete engagement). The process can be explained as follows: in a stable sports team structure, the sports team may have the perception of similarity and closeness around group tasks and social interaction. This process is a team goal, personal role, and good interpersonal relationship formed through task and social integration. On this basis, group norms, social identity, and cultural activation may affect the emotion and behavior of sports members who tend to collectivize further. When the desire of belonging to the team occupies a greater weight in sports decision making, individual members will define their preference, reliance, concern, acceptance, and goal priority in competitive sports according to their team, which is to form psychological a collectivism identity for inner groups. This identification makes members have a stronger self-confidence and sense of responsibility in the face of pressure and challenges. At the same time, relying on the social support and response resources

established by the group environment, it can also effectively resolve all types of physical and psychological discomfort in the process of sports, realize the balance between the athletes and the environment, and obtain high-quality athlete engagement.

6. Conclusions

The four hypotheses proposed in this study were supported. The total score of cohesion and all dimensions can significantly and positively predict athlete engagement, among which ATG-T plays an important role in predicting athlete engagement. Cohesion can affect athlete engagement through a direct and indirect path. The indirect path comprises the intermediary role of psychological collectivism, the intermediary role of mental toughness, and the sequential intermediary role of psychological collectivism and mental toughness. The intermediary effect model constructed in this study has a good fit, which explains 50.5% of the overall variation of athlete engagement, and reveals the mechanism of cohesion on athlete engagement in Chinese team sports to a certain extent.

6.1. Implications

First, athlete engagement can be used as an alternative index of sports performance to appropriately reflect the mechanism of cohesion on individual sports performance from a positive psychology perspective. Compared with sensory indicators, athlete engagement can intuitively reflect the positive experience of individual cognition and behavior. Second, this study contributes to the existing literature by examining the relationship between cohesion and psychological collectivism in more depth, in which psychological collectivism is an important feature of a cohesive sports group. Third, the influence of cohesion on athlete engagement needs to be mediated by some type of stress-resistance ability, in which mental toughness, as an inherited or developed advantage, plays an important role.

In Chinese team sports, psychological collectivism is the embodiment of high-quality cohesion. The increase in cohesion and psychological collectivism can improve Chinese athletes' ability to cope with sports stress situations, which may allow them to achieve a better performance through athlete engagement.

6.2. Limitations and Future Study

Although cross-sectional studies can provide valuable information, such studies cannot determine causality. Longitudinal tracking and experimental design may be used to test the findings of this study in the future.

The priming effect of psychological collectivism in team cohesion is not clear. The theories of implicit cultural and social identity are not enough to show that psychological collectivism is a clear turning point in the process of team building. Most studies believe that coaches and athlete leaders are often viewed as responsible for initiating certain strategies targeted toward improving the group environment. Future research can focus on the coach–athlete relationship and the role of leadership in the formation of psychological collectivism in sports groups.

This study only examined the mediating role of psychological collectivism and mental toughness between cohesion and athlete engagement, and failed to involve other influencing factors, such as team size, formal/informal groups, leadership and member roles, team performance, and reference groups. These factors should be further explored in the future.

This study adopted the project packaging strategy, regarded the athlete engagement as an integral variable, and failed to investigate whether the intermediary model has the same effect on all of the dimensions of athlete engagement. This can be further refined in the future, and the project background cam be taken into account to provide targeted help for sports practice.

The findings were generated based on a sample of Chinese athletes, wherein caution needs to be taken when generalizing the results to other populations. Future studies can utilize a random sampling strategy and collect data from various culture backgrounds.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of Zhejiang Normal University (ZSRT2019045, 30 July 2019).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data in the study are not publicly available in order to protect privacy of the participants.

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Biological, Psychological, and Physical Performance Variations in Football Players during the COVID-19 Lockdown: A Prospective Cohort Study

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Abstract: This prospective cohort study aimed to evaluate whether COVID-19 lockdown caused biological, psychological, and/or physical performance variations in footballers. We compared the 2018/2019 and 2019/2020 seasons evaluating the plasma volume, hematological parameters, iron/ferritin, creatine kinase, vitamin D, cortisol, testosterone, and physiological state of players of the Italian football major league (Serie A). Measurements were performed before the preparatory period (T0), at the beginning (T1) and in the middle (T2) of the championship, and in March (T3) and at the end of season (T4). The results showed that in the 2019/2020 season affected by the lockdown, the weight, BMI, and fat mass percentage were higher than in the previous season. Hematocrit, hemoglobin, red blood cells, and ferritin decreased during both seasons, more significantly than in the regular season. During both seasons, creatine kinase increased from T2 whilst iron concentrations decreased in T3. Testosterone increased in both seasons from T0 to T3 and returned to initial levels at T4; cortisol increased in T2 and T3 during the 2018/2019 season but not during the COVID-19 season. Physical performance tests revealed differences associated with lockdown. Thus, although from a medical point of view, none of the evaluated changes between the two seasons were clinically relevant, training at home during lockdown did not allow the players to maintain the jumping power levels typical of a competitive period.

Keywords: COVID-19 lockdown; hematological parameters; psychological stress; cortisol; testosterone; physical performance; football; Serie A

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1. Introduction

On 11 March 2020, the World Health Organization (WHO) officially declared a pandemic status, caused by the new coronavirus (SARS-CoV-2). The official name given by the World Health Organization to the syndrome caused by the virus is COVID-19 (short for Coronavirus Disease—2019). The pandemic of the viral disease caused by the new coronavirus is still ongoing and returning to normal activities is still a challenge [1].

The need to reduce the risk of disease transmission has also had a huge impact on sport and exercise in general. Team sports activities have been suspended, starting from the football championships up to the pinnacle of sporting excellence, the 2020 Olympic Sports Games. It emerged, in fact, that even elite athletes, who are already normally under competitive stress, are affected by physical and mental conditions consequences of the COVID-19 pandemic [2]. This pandemic-induced mental stress for elite athletes originated

as early as the cancellation or postponement of matches, the ban on training, and the frequent removal and placement of blocks, also generating uncertainty for their athletic career [3,4].

After lockdown, football leagues in Europe have faced a congested schedule with multiple matches per week and short recovery periods to complete the season. This hampered the adequate preparation of players [5], leading to lower physical performance [6] and increased mental stress [7] in the season continuation after the COVID-19 lockdown. The incidence of injuries does not seem to have changed significantly with the return-to-play after the first COVID-19 lockdown in Italian professional soccer players; however, the schedule congestion and changes to the pace of the game seem to have revised the epidemiological data to date [5]. To minimize overtraining and/or injury risks in such periods, football players need the best individual assessment of their health.

Therefore, the purpose of this study was to evaluate any changes in the metabolic, muscle, and hormonal responses of elite-level football players during two consecutive seasons: the pre-pandemic season 2018/2019 and the following one (2019/2020) affected by the COVID-19 pandemic.

2. Materials and Methods

2.1. Design

This was a prospective cohort study performed in a professional elite football club in the Italian Premier League during the 2018–2019 and 2019–2020 seasons up until after the lockdown due to the COVID-19 pandemic (Figure 1). All players were evaluated five times during the study: i.e., T0, T1, T2, T3, and T4. As shown in Figure 1, T0 was scheduled before the start of the preparatory period (week 0; middle July); T1 was about at the beginning of the championship (week 14; October); T2 was programmed in the middle of the championship (week 25; January); T3 was in March (week 35); and T4 was at the end of the season (week 51; June).

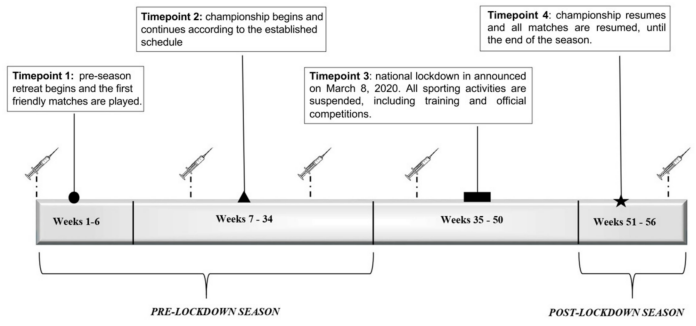

Figure 1. A timeline of the 2019/2020 Serie A season surrounding the impact of the COVID-19 pandemic lockdown.

2.2. Participants

Twenty-four players (aged 22–35 years) from an Italian Serie A football team, participating in both the 2018/2019 and 2019/2020 season, were recruited. As exclusion criteria, samples of blood were not taken from the player if they had any injury during both seasons; players that tested positive to COVID were also excluded. Goalkeepers were excluded due to their specific role in the team. Athletes who attended less than 85% of the scheduled training sessions and matches were also excluded from the study. In total, 17 players were eligible for inclusion in this study.

2.3. Training Program

Table 1 shows the training program followed by the team during the two seasons, differentiated according to the number of games played during the week (one or two). This

program was the same in both seasons, excluding the COVID-19 lockdown, imposed in Italy from 9 March, 2020 to 3 May, 2020.

Table 1. Weekly training schedule, divided into 2018/2019 season, 2019/2020 season (COVID-19), and lockdown period.

PERIOD	Weeks (*n*)	Weekly Volume Mean of Training + Matches (min)	Official Matches/Week (*n*)	Training Sessions/Week (*n*)	Training Distribution (%)			Training Week Activities Description
					Aerobic	Anaerobic	Other	
2018/2019 SEASON	50	571 (min 526–max 616)	1/2	5	35	20	45	~3 high-intensity technical tacticalsessions including simulated soccer matches + 2 or 3 low-intensity technical-tactical sessions + 1 or 2 speed training sessions + 1 or 2 strength training sessions in the gym
2019/2020 SEASON (From week 1 to week 34 and from week 51 to week 56)	40	571 (min 526–max 616)	1/2	5	35	20	45	~3 high-intensity technical tacticalsessions including simulated soccer matches + 2 or 3 low-intensity technical-tactical sessions + 1 or 2 speed training sessions + 1 or 2 strength training sessions in the gym
LOCKDOWN (From week 35 to week 50)	16		0	5	60	30	10	4 or 5 aerobic sessions performed at home with fixed devices (treadmill or bike) or with bodyweight + 2 or 3 strength training sessions using body weight and small weights + 1 or 2 running sessions, (close to home and individually)

The number and duration of training sessions throughout the study were the same for all players. The duration of each training session was 90 min for all players. All training sessions were preceded by a standardized warm-up of 5–15 min.

For weeks where only one match was played on Sunday, the training protocol included sessions on Tuesdays, Wednesdays, Thursdays, Fridays, and Saturdays. Monday was instead set as a day off.

In the weeks in which two games were played (e.g., Wednesday and Sunday), the protocol included training sessions on Mondays, Tuesdays, Thursdays, and Fridays.

During training, football players reach average heart rate values (HR) of 146 beats/min corresponding to approximately 87–97% of the maximum heart rate.

Home-based training during lockdown was performed to maintain players' physical performance levels by programs individually provided by the team's coaches.

2.4. Anthropometric Evaluation

The height of the participants was measured with a Seca stadiometer to the nearest 0.1 cm, while the weight was measured with an Omron balance to the nearest 0.5 kg. Anthropometric-determined measurements included: height (m), weight (kg), body mass index (BMI (kg/m^2) = weight/height^2), percentage of body fat (BFP, %), and fat-free mass (FFM, kg). In particular, the percentage of body fat was estimated, following the measurement of three skin folds (chest, abdomen, and quadriceps) with a GIMA mechanical skinfold meter, using the formula developed by Jackson–Pollock [8]. The percentage of fat-free mass was measured using a bioimpedance analyzer (BIA-AKERN EFG). At each timepoint, anthropometric assessments were also carried out in the early morning, always before each workout.

2.5. Blood Parameters

Venous blood samples were taken following fasting in the early morning (8.00 am) following a day off. Blood (10 mL) was collected in vacutainer tubes, using an anticoagulant. The freshly drawn blood was immediately centrifuged at 3000 $r \cdot min^1$ (825 g) for 10 min to remove the plasma. Analyses were performed using a coulter blood counter (Model

S-plus II, Coulter Electronics inc., Hialeah, FL, USA) and yielded values for hematocrit (Ht), hemoglobin (Hb), red blood cells (RBC), serum iron, and ferritin.

Percentage changes in plasma volume during the study period were assessed by the method described by Saidi et al. (2019) [9].

For the total 25(OH)D measurement, an Abbott Architect 25-OH D reagent on an i2000 Architect analyzer (Abbott Laboratories, Abbott Park, IL 60064, USA) was used with a chemiluminescent competitive delayed phase immunoassay (Chemiflex) standardized according to the NIST SRM 2972 (National Institute of Standard and Technology Standard Reference Material 2972). As previously reported [10], serum testosterone and cortisol were analyzed by the IMMULITE 2000 Immunoassay System (Medical Systems).

Intra- and inter-assay coefficients of variance for cortisol were 4.6% and 7.6%, respectively. The intra- and inter-assay coefficients of variance for testosterone were 3.7% and 5.6%, respectively. Serum testosterone and cortisol reference ranges were 10–75 ng/dL and 7–25 g/dL, respectively.

Normal iron storage (ferritin > 110 $\mu g\ L^{-1}$, Hb > 14 g dL^{-1}), iron depletion (ferritin < 30 $\mu g\ l^{-1}$, Hb > 14 g dL^{-1}), iron deficiency (ferritin < 12 $\mu g\ L^{-1}$, Hb > 14 g dL^{-1}), and iron deficiency anemia (ferritin < 10 $\mu g\ L^{-1}$, Hb < 14 g dL^{-1}) were defined according to population references for iron status measures in males, 24.25.

2.6. Physical Performances

To obtain information regarding the physiological status of youth players, we used tests that have been frequently used in similar studies: countermovement jumps test (CMJ) and Mognoni test.

To minimize any effects of diurnal variation, the three testing sessions were conducted within 2 h of the same time of the day.

Then, each player performed maximal CMJ on the contact platform from a standing position and with the hands on the hips. At the start, the subjects made a preparatory movement: from the extended leg position, they made a rapid bending of the knees until reaching the 90° angle, keeping the heels in contact with the ground and the trunk erect. After the jump, keeping the hands on the hips, the fall was performed with the knees extended, on the tip of the toes with subsequent cushioning to avoid trauma.

The ground reaction force generated during these vertical jumps was estimated with an ergo jump (Opto Jump Microgate, Bolzano, Italy). The height of the jump (cm) was the maximal height reached during the flight phase.

The Mognoni test is a simple method to evaluate the speed at which the athlete reaches OBLA (Onset of Blood Lactate Accumulation).

The test execution protocol provides that the subjects must travel 1350 m in 6 min, maintaining a constant speed of 13.5 km/h [11]. In the field version of this test used in the present study, pins were placed in the path, at regular 50 m intervals, causing players to hear a sound that informed them when the transition at each pin should take place. Immediately upon completion of the 6 min run, the capillary blood lactate concentration was measured from the earlobe with a portable lactate analyzer (Lactate Plus; Nova Biomedical, Waltham, MA, USA): the lower the value of lactate after the test, the better the aerobic fitness level [11].

2.7. Statistical Analysis

Results obtained were stored in Microsoft Office Excel 2016 and statistically analyzed by GraphPad PRISM 5 software (GraphPad Software). All variables used in this study were checked for the normality of distribution before the analyses (Kolmogorov–Smirnov tests). Student's paired *t*-test and Spearman correlation were used. $p < 0.05$ was accepted as a level of statistical significance. All data obtained from the study were expressed as mean ± standard deviation.

3. Results

3.1. Anthropometric Characteristics of Football Players

The anthropometric characteristics of the players (weight, height, body mass index, percentage of body fat BFP, and fat-free mass FFM) measured during the two seasons analyzed are shown in Table 2.

Table 2. Anthropometric characteristics of football players during different times during the 2018/2019 and 2019/2020 seasons.

Parameters	T0	T1	T2	T3	T4
COVID season					
WEIGHT (kg)	86.3 ± 6.0	86.9 ± 6.5	86.3 ± 6.5	87.7 ± 7.4 §	86.8 ± 7.0 $^{*,\circ}$
HEIGHT (m)	1.78 ± 4.9	1.78 ± 4.9	1.78 ± 4.9	1.78 ± 4.9	1.78 ± 4.9
BMI (kg/m^2)	24.7 ± 0.6	24.6 ± 0.9	24.4 ± 0,7	24.8 ± 1.0 §	24.6 ± 0.9
BFP (%)	9.4 ± 1.8	9.1 ± 2.1	8.1 ± 1.2 $^{*,\#}$	7.9 ± 1.4 $^{*,\#}$	7.9 ± 1.4 $^{*,\#}$
FFM (kg)	78.5 ± 4.6	79.5± 5.3	80.5 ± 5.9	80.3 ± 6.6 ^{*,A}	79.8 ± 6.21 ^{*,A}
2018/2019 season					
WEIGHT (kg)	85.6 ± 2.5	85.0 ± 3.5	85.1 ± 3.2	84.5 ± 3.0 $^{*,\#}$	84.0 ± 2.7 $^{*,\#}$
HEIGHT (m)	1.77 ± 5.6	1.77 ± 5.6	1.77 ± 5.6	1.77 ± 5.6	1.77 ± 5.6
BMI (kg/m^2)	24.7 ± 1.0	24.5 ± 0.4	24.6 ± 0.9	24.4 ± 1.0	24.3 ± 1.1
BFP (%)	8.9 ± 0.7	8.6 ± 1.1	8.5 ± 0.9	7.9 ± 1.0 $^{*,\#,\S}$	7.6 ± 1.1 $^{*,\#}$
FFM (kg)	78.2 ± 2.3	79.0 ± 3.2	80.3 ± 2.2	81.6 ± 2.1 $^{*,\#}$	82.3 ± 2.0 $^{*,\#}$

* Statistical difference from T0. $^{\#}$ Statistical difference from T1. § Statistical difference from T2. $^{\circ}$ Statistical difference from T3. ^{A} Statistical difference from 2018/2019 season.

The reported values show some statistical differences ($p < 0.05$) between the various points of the season. In addition, in the 2019/2020 season (COVID-19), there were higher weight values ($p = 0.01$) and BMIs ($p = 0.03$) and lower percentages of FFM ($p = 0.01$), due to the forced stop period.

Exercise is known to affect hematological variables: some studies have reported a stimulation of erythrocytosis with a consequent reduction in the values of HT and HB in athletes [12]. However, it is also known that excessive physical exercise induces the physical destruction of red blood cells, also causing decreases in HT and HB [13,14]. Thus, we monitored these hematological variables, and the values measured were within the physiological ranges (4.2–5.6 $\times$ 10^{12}/L for RBC; 13.0–17.5 g/dL for HB; 37–54% for HT). However, decrements in HB, RBC, and HT during both seasons (Figure 2), mostly significant in the 2018/2019 regular season were observed (Table 3).

3.2. Vitamin D–Iron–Ferritin

In both seasons, vitamin D significantly decreased in T3 (<30 ng/dL; $p < 0.05$); in the 2019/2020 season (COVID-19), only vitamin D levels were also low in T2 (Figure 3 and Table 4). Cross-sectional studies indicated an association between low vitamin D concentration and low iron state [15], but we found no association ($p > 0.05$ by Spearman's rank correlation). Ferritin levels decreased in T1 and T2 during the 2019/2020; however, a major decrement was observed in T2-T4 periods during the 2018/2019 season. Iron concentrations decreased in T3 in both seasons (Figure 3 and Table 4).

3.3. CK–Cortisol–Testosterone–T/C Ratio

During both seasons, CK increased starting from T2 to the end of the seasons (Figure 4A,B and Table 5). As reported previously [10], cortisol concentrations increased significantly in T2 and T3 during the 2018/2019 season; nevertheless, such an increment was not found during the 2019/2020 (COVID-19) period (Figure 4C,D and Table 5).

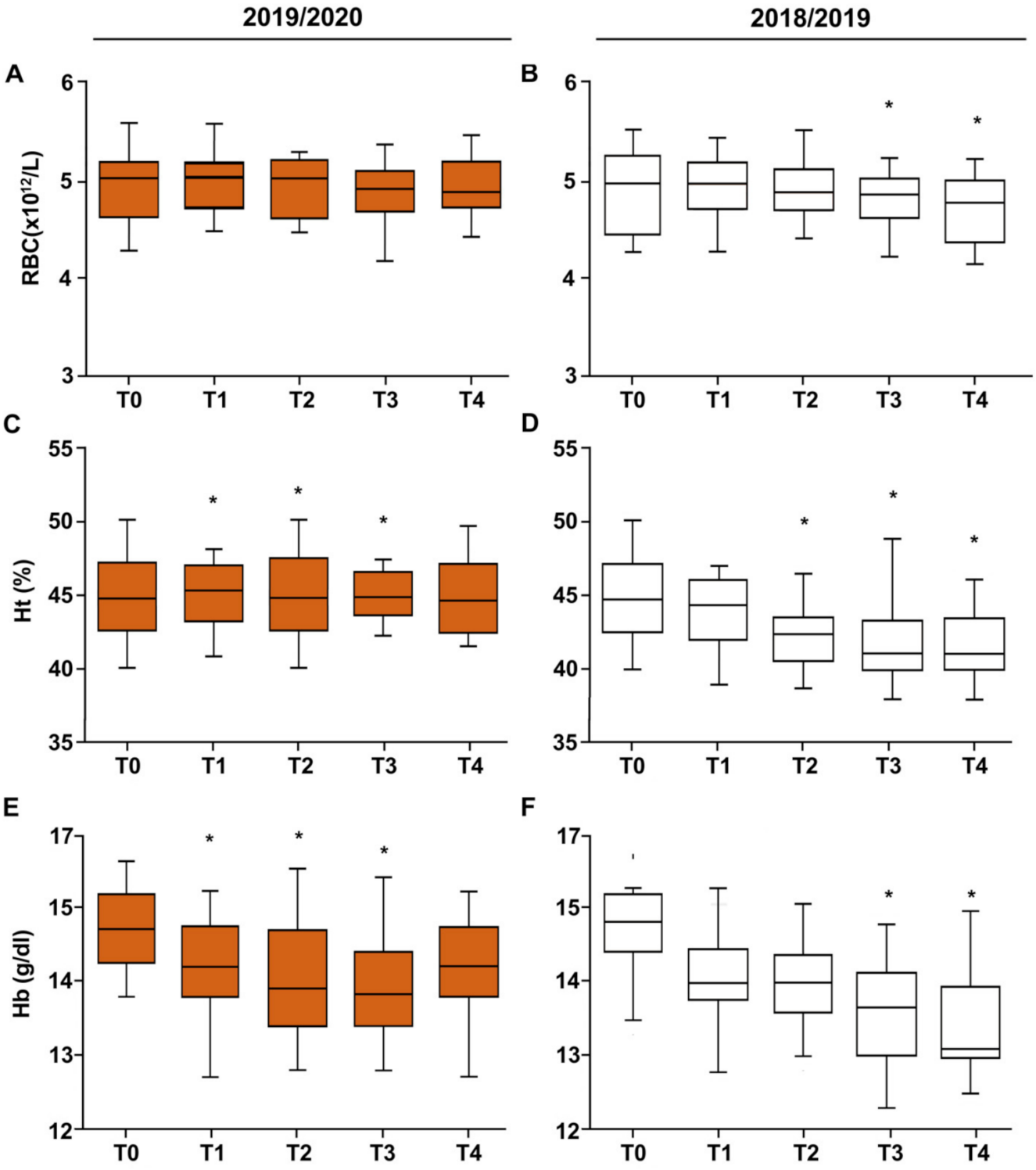

Figure 2. The effects of training on serum red blood cells (**A**,**B**), hematocrit (HT) percentage (**C**,**D**), and hemoglobin concentration (**E**,**F**) in football players during the 2018/2019 and 2019/2020 seasons. Box and whiskers representation of red blood cells, hemoglobin concentration, and hematocrit (HT) percentage evaluated five times (T0, T1, T2, T3, and T4) during the seasons. In this representation, the central box covers the middle 50% of the data values, between the upper and lower quartiles. The bars extend out to the extremes, while the central line is at the median. *p*-values were obtained by Student's paired *t*-test between each timepoint and T0. * $p < 0.05$.

Table 3. Differences (Δ) in red blood cells and hemoglobin concentration, hematocrit percentage, and plasma volume between each timepoint in football players for 2018/2019 and 2019/2020. *p*-values < 0.05 obtained by *t*-test show statistical differences in Δ values.

	COVID Δ	2018/2019 Δ	*p*
Erythrocytes (M/mm^3)			
T0–T1	0.02 ± 0.07	−0.2 ± 0.10	0.05
T1–T2	−0.04 ± 0.35	−0.04 ± 0.43	0.48
T2–T3	−0.03 ± 0.34	−0.07 ± 0.16	0.26
T3–T4	0.05 ± 0.39	−0.12 ± 0.27	0.03
T0–T4	0.01 ± 0.37	−0.25 ± 0.45	0.02
Hematocrit (%)			
T0–T1	0.26 ± 2.77	−0.75 ± 3.42	0.06
T1–T2	−0.15 ± 2.79	−1.74 ± 2.43	0.03
T2–T3	0.13 ± 2.96	−0.57 ± 2.81	0.22
T3–T4	0.03 ± 2.62	−0.23 ± 0.75	0.32
T0–T4	0.28 ± 3.35	−3.28 ± 3.59	0.0001
Hemoglobin (g/dL)			
T0–T1	−0.54 ± 0.77	−0.57 ± 0.69	0.44
T1–T2	−0.14 ± 1.00	−0.15 ± 0.72	0.49
T2–T3	−0.12 ± 0.43	−0.34 ± 0.82	0.10
T3–T4	0.29 ± 0.83	−0.32 ± 0.81	0.009
T0–T4	−0.51 ± 0.71	−1.37 ± 0.84	0.001
Δ PV (%)			
T0–T1	−11.07 ± 9.28	5.41 ± 10.19	0.000004
T1–T2	1.77 ± 9.66	4.73 ± 8.79	0.05
T2–T3	0.87 ± 7.38	2.78 ± 8.10	0.15
T3–T4	−1.76 ± 9.31	2.58 ± 6.89	0.06
T0–T4	−11.22 ± 9.99	15.27 ± 10.16	0.0000002

Table 4. Differences (Δ) in ferritin, iron, and vitamin D concentration between each timepoint in football players for 2018/2019 and 2019/2020. *p*-values < 0.05 obtained by *t*-test show statistical differences in Δ values.

	COVID Δ	2018/2019 Δ	*p*
Ferritin			
T0–T1	−8.72 ± 3.66	12.17 ± 3.84	0.02
T1–T2	−3.35 ± 3.98	−98.91 ± 6.57	0.000006
T2–T3	5.97 ± 4.00	17.35 ± 6.07	0.26
T3–T4	−1.55 ± 0.47	−14.60 ± 6.41	0.23
T0–T4	−7.65 ± 4.14	−3.89 ± 5.16	0.000001
Iron			
T0–T1	−3.94 ± 2.98	−1.54 ± 3.6	0.31
T1–T2	4.94 ± 3.16	1.50 ± 2.98	0.31
T2–T3	−10.20 ± 3.44	−3.96 ± 2.74	0.24
T3–T4	7.65 ± 3.79	−1.00 ± 4.90	0.14
T0–T4	−1.55 ± 3.46	−5.00 ± 3.22	0.33
Vitamin D			
T0–T1	−4.09 ± 1.53	−0.37 ± 1.12	0.13
T1–T2	−7.14 ± 1,12	−1.92 ± 1.83	0.10
T2–T3	−3.29 ± 9.09	−10.70 ± 1.24	0.01
T3–T4	8.10 ± 1.57	5.39 ± 1.51	0.16
T0–T4	−6.43 ± 1.57	−7.60 ± 1.65	0.16

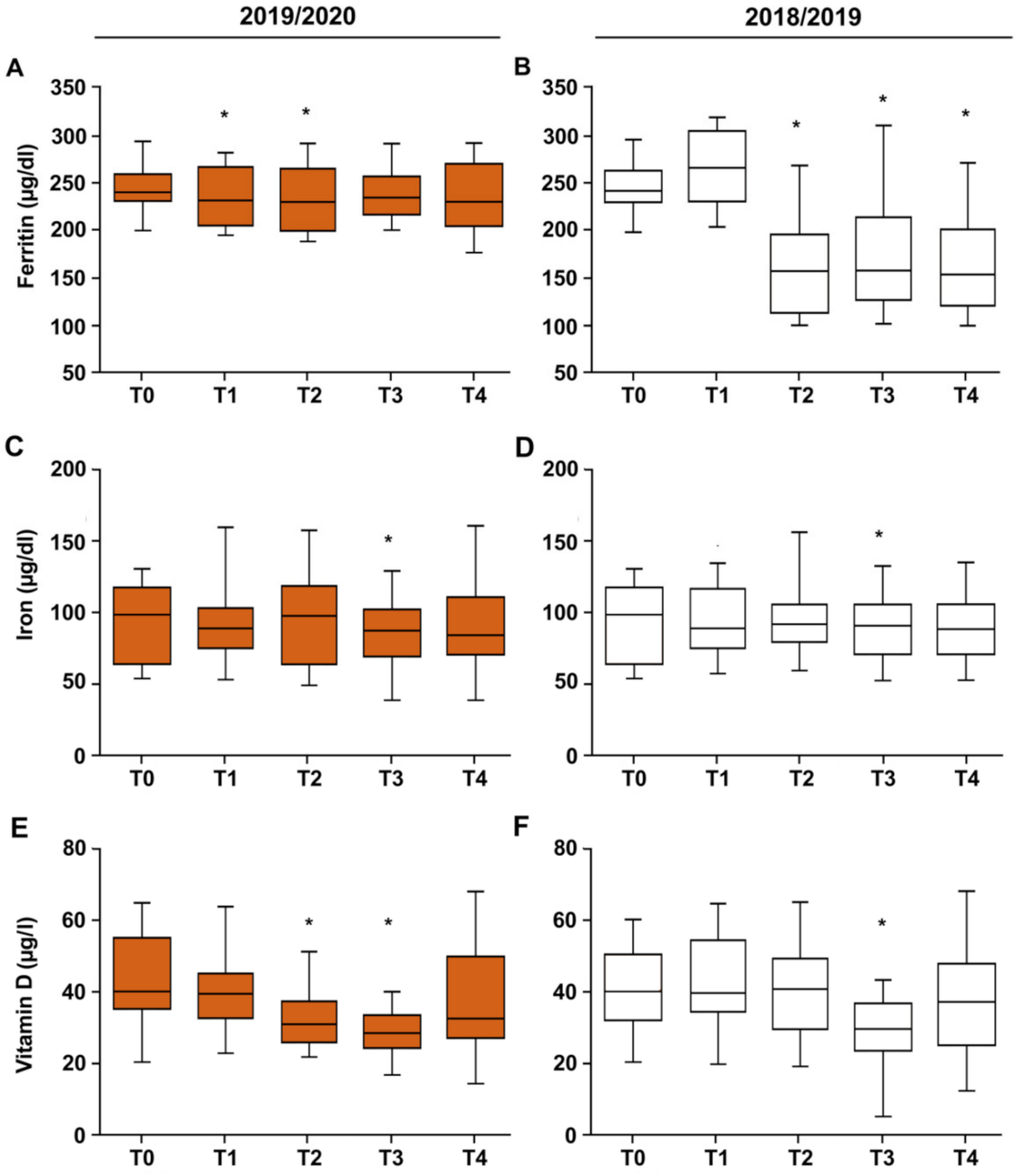

Figure 3. The effects of training on serum ferritin (**A**,**B**), iron (**C**,**D**), and vitamin D (**E**,**F**), concentration in football players during the 2018/2019 and 2019/2020 seasons. Box and whiskers representation of serum ferritin, iron, and vitamin D evaluated five times (T0, T1, T2, T3, and T4) during the seasons. In this representation, the central box covers the middle 50% of the data values, between the upper and lower quartiles. The bars extend out to the extremes, while the central line is at the median. *p*-values were obtained by Student's paired *t*-test between each timepoint and T0. * $p < 0.05$.

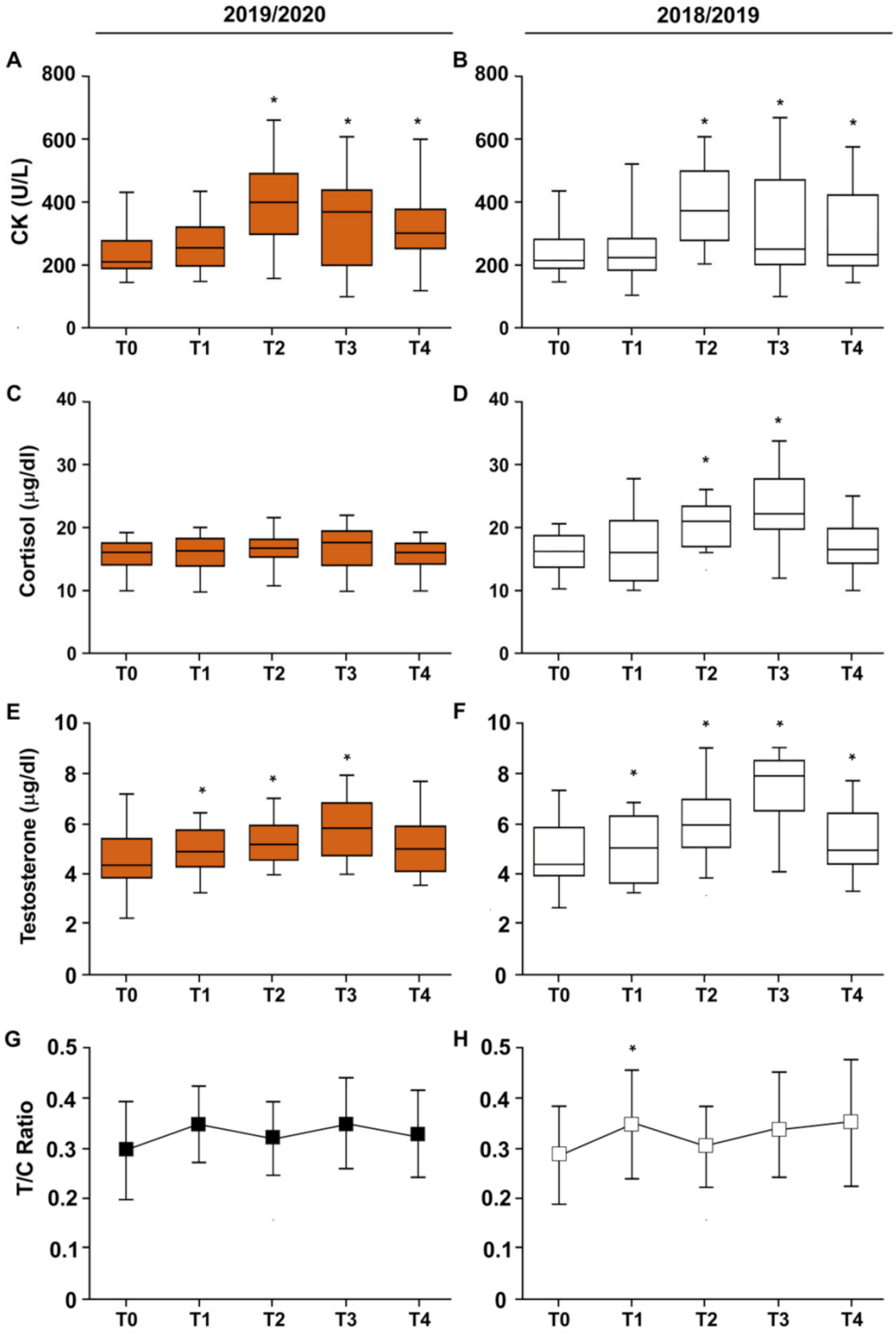

Figure 4. The effects of training on serum CK (**A**,**B**), cortisol (**C**,**D**), testosterone concentration (**E**,**F**), and T/C ratio (**G**,**H**), in football players during the 2018/2019 and 2019/2020 seasons. Box and whiskers representation of serum CK, cortisol, and testosterone concentration and T/C ratio evaluated five times (T0, T1, T2, T3, and T4) during the seasons. In this representation, the central box covers the middle 50% of the data values, between the upper and lower quartiles. The bars extend out to the extremes, while the central line is at the median. *p*-values were obtained by Student's paired *t*-test between each timepoint and T0. * $p < 0.05$.

Table 5. Differences (Δ) in CK, cortisol, and testosterone concentration and T/C ratio between each timepoint in football players all for 2018/2019 and 2019/2020. *p*-values < 0.05 obtained by *t*-test show statistical differences in Δ values.

	COVID Δ	2018/2019 Δ	*p*
CPK (U/L)			
T0–T1	35.3 ± 8.6	3.9 ± 4.2	0.05
T1–T2	135.5 ± 1.6	141.8 ± 1.6	0.43
T2–T3	−64.8 ± 2.13	−64.8 ± 1.7	0.50
T3–T4	−11.3 ± 2.19	−8.2 ± 5.7	0.47
T0–T4	94.7 ± 1.43	72.7 ± 1.29	0.30
Cortisol (μg/dL)			
T0–T1	0.1 ± 3.48	1.1 ± 6.01	0.19
T1–T2	0.7 ± 3.46	3.4 ± 6.83	0.03
T2–T3	0.2 ± 4.26	2.9 ± 6.84	0.03
T3–T4	−0.9 ± 3.69	−6.8 ± 6.21	0.0001
T0–T4	0.1 ± 3.35	0.6 ± 4.02	0.23
Testosterone (μg/dL)			
T0–T1	0.9 ± 1.81	1.0 ± 1.45	0.40
T1–T2	−0.2 ± 1.26	0.6 ± 1.05	0.002
T2–T3	0.5 ± 1.69	1.4 ± 1.66	0.05
T3–T4	−0.6 ± 1.66	−2.0 ± 1.89	0.007
T0–T4	0.6 ± 1.54	1.0 ± 1.45	0.14
T/C ratio			
T0–T1	5.1 ± 13.67	6.0 ± 15.00	0.39
T1–T2	−2.5 ± 10.84	−4.3 ± 13.54	0.30
T2–T3	2.9 ± 13.29	2.9 ± 11.70	0.49
T3–T4	−2.2 ± 10.58	1.8 ± 15.80	0.01
T0–T4	3.3 ± 10.41	6.4 ± 13.05	0.20

Testosterone concentration increased in both seasons from T0 to T3 and, at the end of the season, it decreased toward initial levels; although such a decrement was statistically significant in both seasons ($p < 0.05$), it was higher in the 2018/2019 season (Figure 4E,F).

The testosterone to cortisol ratio (T/C) increased only in T1 of the 2018/2019 season; in all other periods, it did not show significant changes (Figure 4G,H).

3.4. Electrolytes

The clinical chemistries shown in Table 6 represent common clinical chemistries used to monitor clinical aspects of electrolytes and metabolism.

Table 6. Differences (Δ) in electrolytes concentration between each timepoint in football players for 2018/2019 and 2019/2020 seasons. *p*-values < 0.05 obtained by *t*-test show statistical differences in Δ values.

Parameters	T0	T1	T2	T3	T4
2018/2019 season					
Magnesium (mg/dL)	2.25 ± 0.16	1.86 ± 0.14 $^{\#}$	2.04 ± 0.13 $^{\#,*}$	1.90 ± 0.13 $^{\#}$	2.15 ± 0.12 $^{*,\$}$
Sodium (mmol/L)	142.25 ± 3.60	142.29 ± 3.59	140.17 ± 4.91	144.29 ± 3.51 §	141.25 ± 3.84 $^{\$}$
Potassium (mmol/L)	4.37 ± 0.30	4.38 ± 0.29	4.57 ± 0.28	4.44 ± 0.23	4.41 ± 0.27
2019/2020 season					
Magnesium (mg/dL)	2.25 ± 0.12	1.94 ± 0.12 $^{\#}$	2.03 ± 0.13 $^{\#}$	2.05 ± 0.25 $^{\#,*,A}$	2.21 ± 0.17 *,§
Sodium (mmol/L)	142.25 ± 3.84	142.58 ± 1.53	140.92 ± 1.32 *	143.33 ± 1.17 ^{§,A}	141.96 ± 1.52
Potassium (mmol/L)	4.37 ± 0.27	4.36 ± 0.29	4.71 ± 0.33 $^{\#,*}$	4.60 ± 0.36	4.46 ± 0.38

$^{\#}$ Statistical difference from T0. * Statistical difference from T1. § Statistical difference from T2. $^{\$}$ Statistical difference from T3. ^{A} Statistical difference from 2018/2019 season.

3.5. Physical Performances

No significant changes were observed for the CMJ Test (Table 7). However, the between-period comparison revealed significant differences because the changes associated with the COVID-19 lockdown were significantly worse than those occurring during the 2018/2019 competitive season (Table 7).

Table 7. Differences (Δ) in blood lactate concentrations and CMJ between each timepoint in football players all for 2018/2019 and 2019/2020. *p*-values < 0.05 obtained by *t*-test show statistical differences in Δ values.

	COVID Δ	2018/2019 Δ	*p*
Lactate—mmol × L^{-1}			
T0–T1	−0.81 ± 0.06	−0.90 ± 0.10	0.34
T1–T2	−0.86 ± 0.15	−0.92 ± 0.34	0.08
T2–T3	−0.45 ± 0.34	−0.60 ± 0.15	0.26
T3–T4	0.90 ± 0.39	−0.50 ± 0.30	0.01
T0–T4	−0.80 ± 0.37	−1.60 ± 0.50	0.03
CMJ—height jump (cm)			
T0–T1	1.17 ± 0.77	1.10 ± 0.69	0.44
T1–T2	1.76 ± 1.00	1.80 ± 0.22	0.49
T2–T3	0.84 ± 0.43	0.90 ± 0.82	0.10
T3–T4	0.10 ± 0.83	1.52 ± 0.81	0.02
T0–T4	−0.51 ± 0.71	3.61 ± 0.84	0.001

Analysis of blood lactate concentrations during the competitive seasons showed a significant decline, but a significant increase was observed following COVID-19 lockdown. Consequently, between-period differences were significant when the COVID-19 lockdown period was compared with the 2018–2019 competitive period (Table 7).

4. Discussion

Due to physiological and performance adaptations to training, professional football players are subjected to several alterations in health [16,17] and performance [18] throughout the course of the season. Although a variety of research has investigated performance testing and/or observational approaches to explore the relationship between training load and training outcomes (e.g., acute responses, chronic responses, and injuries) [19], limited information is available regarding blood parameters (e.g., iron storage and hormonal environment) of elite football players from the same team, before and after a different period of match play and training, even more since March 2020, when the COVID-19 pandemic forced most activities in Italy, including football, to stop. During lockdown, players could only train at home, with limited evidence regarding the effect of this period [20]. Therefore, this study aimed to investigate the effect of COVID-19 lockdown on professional football players. Thus, we describe the seasonal changes in anthropometric and body composition indicators, hormonal status, and performance in a professional football team, during two different sporting seasons: the regular 2018/2019 season and the 2019/2020 season that was stopped from March to May and finished on 2 August 2020.

Data from anthropometric, blood values, and hormonal parameters showed differences between the two seasons, proving that the forced stop period affected the physical and physiological state of professional football players. According to numerous studies, anthropometric and body composition indicators are important factors, which can predict the specific footballer's performance, already in his adolescence [21]. In the 2018/2019 season, without any interruption, there was a constant decrease in weight, BMI, and percentage of fat mass and an increase in fat-free mass. In the 2019/2020 season that underwent the forced stop, however, the same trend was recorded but up to T1. In T2 and T3 periods, there was an increase in weight and BMI, while the percentages of fat mass and lean mass remained almost constant.

It is well established that training may alter homeostasis, hematological parameters included. Hb is a key determinate of oxygen transport and consumption [22], which is related primarily to aerobic capacity [23]. Elevated Hb is generally associated with an increase in blood oxygen transport capacity, while an increase in Ht increases blood viscosity [24]. Thus, it seems beneficial to monitor football players' Hb and Ht parameters. Several studies showed decreases in Hb and HT values after periods of intense training or competition [25]. These declines are known as an adaptation to training [26]: erythrocytosis during exercise induces an increase in the absolute concentration of Hb [16], but this mechanism is masked by a rise in plasma volume (PV) [27]. PV expansion compensates for the negative effects of acute blood concentration induced by intense training. In fact, an increase in aldosterone levels and osmotically active plasma proteins, as well as a decrease in the activity of urodilatin, eventually lead to fluid retention and PV increment [28]. This increase in PV is a first sign of overtraining [27].

To date, only a few studies have evaluated Hb and HT values during an entire competitive season in football players [9,29]. Particularly, Silva et al. [30] observed that the Hb and HT of Brazilian football players increased significantly after 12 weeks of training. These authors postulated that such alterations were due to the plasma volume decrement observed after the football-training program. A study of Saidi et al. [9] suggested a significant change in various hematological parameters with negative effects on physical fitness during 6 weeks of congested match play. In contrast, Heisterberg et al. [31] and Rago et al. [29] recorded no significant changes in Hb and HT levels over a 6 month period in which the training and match load varied considerably. Ostojic et al. [32] found a significantly higher HT at preseason compared with other sampling periods, and no other differences were found between any of the hematologic variables during the whole season. These differences in the results obtained in these studies could be due to psychological factors, players' diet [33], and/or differences between players' effective match time.

In the present study, we hypothesized that in the period of congested games (between T3 and T4), in which the championship resumed after the COVID-19 lockdown, the football matches would have negatively affected the plasma volume and hematological parameters. Instead, apart from a slightly decreased Hb during the COVID-19 season, we did not find significant changes in the hematological variables tested. In addition, it should be remarked that during the COVID-19 season (i.e., when the training load is discontinuous), the hemodilution was absent. This phenomenon observed during the 2018/2019 season could be a favorable adaptation to training because decreased blood viscosity allows greater cardiac output. Instead, erythrocytes, Hb, HT, and plasma volume values decreased during the 2018/2019 season, without any interruption. Regarding erythrocytes, in agreement with our results in the 2018/2019 season, many studies have suggested that the number of erythrocytes decreased at the end of a competitive period [9]. In general, erythrocytes, Hb, and HT decrease after endurance training [34]. This is mainly caused by PV expansion [35]. In fact, Silva et al. [30] were able to show that the altered percentage of erythrocytes significantly correlated with plasma volume change (i.e., reductions) during the 12 week football training program. Among others, adequate serum iron levels seem to be the main factor for optimal hemoglobin production, maximal oxygen uptake (VO_2max), and high sports performance in football [36]. Several investigators suggested that the iron status of elite athletes also varies during the season because of different training regimes [37]. The iron depletion in top-level football players based on low serum ferritin levels could be crucial for predicting optimal physical performance [38]. In fact, it seems that ferritin values decrease with the training load, suggesting that ferritin could be a marker of training tolerance in endurance athletes [39]. In accordance with other studies [39], in our study in footballers, ferritin showed a constantly decreasing trend from the initial phase of both seasons. Thus, the serum ferritin level strongly decreased, especially during the first part of the regular season (T1–T2). Iron is essential for normal cell biology. However, excess iron might be potentially harmful, as it can catalyze the formation of toxic reactive

oxygen species. Therefore, the decreased levels of serum iron, observed along both seasons considered, might be an adaptive response [40].

Vitamin D, mainly synthesized by the skin when exposed to ultraviolet B radiation (UVB), is involved in several physiological processes as the maintenance of calcium, phosphate, and iron homeostasis [41]. During winter, vitamin D deficiency can occur in up to 50–80% of the population [42]. Although an optimal vitamin D level helps to maintain the musculoskeletal system efficiency [43], studies on athletes highlighted a surprisingly high prevalence of vitamin D insufficiency, both in outdoor and indoor disciplines [44]. Thus, even outdoor training (such as by football players) is not protective against vitamin D deficiency [45] and many studies performed in European football players during the winter season showed serum vitamin D levels below the normal range (defined by the latest guidelines as 30–50 ng/mL) [46,47]. Our data confirmed the high prevalence of low serum concentrations of vitamin D in professional male athletes [48] in winter. In both seasons, the mean concentration of Vitamin D was insufficient (defined as a serum level of 20–30 ng/mL) in T3 (in March) and in the COVID-19 season also in T2. Surprisingly, this was also true in the 2018/2019 season, when football players trained outdoors 2 h a day.

Creatine kinase (CK), cortisol, testosterone, and the testosterone/cortisol ratio (T/C) have been used to assess athletes' response to training load [49,50]. Precisely, CK levels have been used to monitor muscle damage and post-match neuromuscular fatigue in elite football players [51] and other sports [49,50]. Most studies have reported data from single-match experiments [52] or short-term studies [53] and much less information is available on long-term studies during the entire season in elite professional football [54]. In the present study, in T2, T3, and T4 of both seasons, CK values were slightly above 270 $U \cdot L^{-1}$, set as the highest reference value for the general population. High values of CK have been suggested as a symptom of overreaching or overtraining [55] and unusually higher values of CK have been routinely measured in blood samples from football players (until 1492 U/L) [55]. This may be related to the nature of football training and playing involving a great deal of weight-bearing activities, which include eccentric (lengthening) contractions of the leg muscles [55]. In addition, football playing can induce muscle damage due to mechanical impact with other players. Finally, football training and competition are often performed under severe environmental conditions, and football games are among the longest (90 min) and most energy-demanding sporting activities [56].

Plasma cortisol and testosterone are sensitive to training periods that differ in volume and intensity and to the frequency of matches during the competitive period [10]. Many factors influence this delicate hormonal balance, not only training workloads, training schedules, and competition factors but also psychological stress. If the physical demands of training and competition are too great, one might assume that catabolic activities will predominate. However, when the body successfully copes with the demands, the anabolic metabolism can improve the performance during different periods of the competitive season [57]. Thus, testosterone and cortisol values can be considered important parameters that help to evaluate the influence of these factors because of the balance between anabolic and catabolic processes [58]. Some studies have identified a significant increase in cortisol concentration, in football players [10,59], due to an increased training intensity. This is probably caused by hyperresponsiveness of the hypothalamic–pituitary–adrenal (HPA) axis due to a physiological adaptation of the neuroendocrine system to training [60]. In addition, a substantial increase in cortisol, at the end of the football season, may be explained by tiredness due to the higher number of matches placing a higher physical load, as well as psychological pressure, on the players [61]. The results obtained from this study show that the hormonal concentrations of cortisol and testosterone are higher during the 2018/2019 season, in which the football players trained regularly and played all the official matches. The increase in plasma cortisol during the 2018/2019 season may represent a typical homeostatic adaption process to the soccer training and to a stressful environment and competitions [10], with an increment by 20% during the T0–T2 timepoint. In contrast, other studies have shown a significant decrease in cortisol concentration

after long periods of training in elite football players [16,62]. In accordance with both Saidi et al. [9] and Requena et al. [18], we observed no changes in cortisol concentration in elite football players, during the 2019/2020 season.

Though we would have expected a significant increase in plasma cortisol after the lockdown, it should be noted that the absence of a significant change in its concentration could be attributed to the lack of stress due to the weekly official sports competitions, rather than the high level of fitness of the players and/or their usual high daily and weekly training volume over the course of the season. Several studies have documented the effects of COVID-19 on the psychological stress experienced in the general population [63], and it is known that uncontrolled stressors activate the HPA axis: through the association of the cortex, amygdala, hippocampus, and adrenal glands, blood cortisol increases [64]. As high levels of stress can have a detrimental impact on everyday life and mental and physical health, there would be a need to examine and diagnose psychological problems and deteriorating mental health among professional athletes during the COVID-19 pandemic. In fact, training restrictions and competition avoidance, due to COVID-19 lockdown, decreased competitions performance, substantiating the contribution of cognitive distress to the overall perception of effort and to performance outcome [20]. However, previous studies have reported that COVID-19 preventive measures did not provoke changes in the levels of anxiety, stress, and symptoms of depression in professional footballers [65,66]. Our study confirmed that the professional players cope very well with the changes due to COVID-19, with no noticeable changes in cortisol, indicating good psychological adaptation. Therefore, from a practical point of view, training regimens and healthy behaviors during pandemic crises could be introduced as standard habits for health and well-being. In the pandemic period in response to social distancing, coaches and athletes had to adopt a constructive problem-solving attitude and make structural changes to the training environment. Although the time spent for sport-specific training was reduced, individualized home-based training was implemented; this could have turned into improved training conditions. Indeed, at the Tokyo 2020 Olympics, swimmers' performance trend was maintained despite the unprecedented characteristics of the previous period of preparation, demonstrating that the supposed effects of the COVID-19 lockdown on elite athletes' performances were not apparent. Financial, social, psychological, scientifical, and technological support environments of Olympics participants could safeguard the subsistence of performances even in the case of periods of difficulty never faced before [67].

The change in anabolic hormonal concentrations could be due to interactive modifications of various endocrine parameters, and to the effects of modifications of the hypothalamic–pituitary axis on the testicles and adrenal glands. The training-induced increases in serum testosterone reflect the anabolic activity increment related to the volume of strength training and to physical performance improvements [68]. In our study, we observed that after an intense training period, testosterone concentrations increased in both seasons, remaining in normal ranges, as also reported by others [10,69]. However, decreases in testosterone have also been reported after long-term football training, perhaps due to excessive training intensity, accumulated fatigue, or physical fitness declines [9]. The testosterone concentration decrement found in T3 during the COVID-19 season might be due to tiredness caused by the high number of matches played and to the psychological pressure at the end of the lockdown period. Regarding the T/C ratio, results showed an increase from T0 to T1, during the 2018 season. According to some studies, the T/C value increment is indicative of a good training setting and can reflect physical performance improvements [70,71]. However, in contrast to these investigations, other recent studies showed a significant decrease in the T/C ratio in professional football players [9,61], as being due to neuromuscular fatigue caused by an increase in training intensity that might be related to physical performance declines [9]. The divergence of these results can be explained by differences in training programs (frequency, duration, and intensity) and/or participants' expertise level (training history). These two hormones appear sensitive to the intensity and volume of football training and other factors such as fatigue or mood and, if

properly interpreted, could provide a tool for monitoring workload and fitness. Despite the least amount of work carried out during the COVID-19 period, aerobic fitness, as measured by the Mognoni test, improved after the lockdown. There was also a significant difference between the same timepoints of COVID-19 and 2018–2019 seasons.

In addition to training volume, training intensity is another key factor that may influence aerobic adaptations [24]. Specifically, high-intensity interval training can elicit significant improvements in highly trained athletes, whereas additional submaximal endurance exercise does not seem to lead to further changes [23]. Additionally, in normal circumstances (i.e., during the competitive period), the training volume is not entirely dedicated to the improvement of players' physical capacities, because technical-tactical drills are performed more frequently. This kind of exercise may not always reach an adequate intensity to elicit positive adaptations, whereas during the COVID-19 lockdown period, training activities were mainly focused on physical conditioning, which, in turn, probably induced superior positive aerobic adaptations.

The findings from this study are related to only one Italian football team, but different restrictions in other countries might have had different effects on football players' physical performance and psychological implications.

In addition, different home-based training strategies (including the different equipment) could result in different adaptations, in biological and physical performance, on football players.

5. Conclusions

This study was conducted to provide reference data in professional football players, especially under stressful conditions, such as the pandemic period. Despite the spontaneous variability in most parameters, there were significant changes during both seasons in hematocrit, hemoglobin, iron, ferritin, vitamin D, and testosterone.

However, from a medical perspective, none of the changes were considered clinically relevant to a player's health or training status, because all were within normal values and most likely typical modulations of homeostatic concentrations in response to a stressful environment, training, and competition. In addition, this study showed that the training volume during home confinement in the COVID-19 period was probably insufficient to allow professional football players to maintain the jumping power of competitive periods. These changes might be not relevant enough to possibly interfere with clinical decisions in football players.

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Anthropometric, Physiological, and Psychological Variables That Determine the Elite Pistol Performance of Women

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Abstract: Shooting is a high-precision sport that depends on many factors to achieve high performance levels. The main objective of this study was to analyze the differences in anthropometric, physiological, and psychological variables by sport level in women air-pistol shooters. Fifteen female pistol shooters, including seven elite national shooters of Iran and eight non-elite shooters, participated in this study. Analyzed variables were grouped into three sections: anthropometric, physiological, and psychological. Anthropometric variables included: height, weight, body mass index, length of leg, arm span, and proportions between variables. Physiological tests include resting heart rate, static and dynamic balance, flexibility, and upper body strength. Additionally, psychological questionnaires of SMS-6 sport motivation, TSCI trait sport-confidence and SSCI state sport-confidence, ACSI-28 athletic coping skills, and SAS sport anxiety scale were used. The Shapiro–Wilks test and independent t-test were used to analyze the data. Effect size and test reliability were calculated using Cohen's *d* and Cronbach's alpha, respectively. Our results showed that elite shooters have higher values of dynamic balance (Y-test), upper body strength (sit-ups), and intrinsic motivation, and lower resting heart rate than non-elite. However, no differences were found in the anthropometric variables, nor in anxiety or coping skills. We conclude that physiological and psychological workouts should be included in the shooters' training programs to improve their performance.

Keywords: shooting; profile states; strength; balance; anxiety; coping skills; motivation

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1. Introduction

Shooting is a high-accuracy [1] sport in which age is not a limiting variable of performance [2]. However, good skills and physical fitness, such as strength, flexibility, endurance, and balance, are needed [3]. Shooters should have good levels of coordination and control their limbs, joints, and muscles during competition to achieve an optimal performance, because this skill is related to the level of physical and mental fitness [4]. In addition, anthropometric factors are usually important in sports, but in shooting performance, there seems to be no specific body type [5].

Regarding anthropometric factors, measuring body mass index (BMI) [6] and examining the body structure of an athlete, such as height (stand and sit), limb length (arm span, leg length) [7], or some proportions such as sitting height divided by standing height and sitting height related to leg length [8], could determine the athletic balance [9] and the potential to achieve greater success. In this line, some authors noted that tall or long-limbed athletes would have more body sway or tremor. This tremor size in the limbs or body sway could be affected by the feet position [10], age, weight, and height and could have a

negative effect on balance [5] and shooting performance [11]. Interestingly, heavy shooters have different body-sway patterns than thinner shooters because the center of gravity has a direct effect on body movement and performance [12]. Furthermore, when shooters are compared to athletes from other sports, they seem to be heavier and shorter [5], which could suggest a preferential morphology profile in the Olympic shooting sport. In contrast, other studies concluded that height was not related to balance [7], body sway does not affect pistol shooting performance [13], and there is no relationship between weight and center of gravity [5].

In addition to balance, shooters need several physiological factors to achieve high levels of performance [14], including muscular strength [15,16] and hand–eye coordination [4]. Thus, the strength levels of core muscles, such as abdominal, spinal, or diaphragm, seem to be important by the shooters [17] and could be critical to reduce body sway and achieve high performance levels [18]. Moreover, the strength level of muscles such as finger flexors and the deltoid [6,19] have been related to the movements of the barrel of a weapon [20], which directly affect performance [21,22].

Another important physiological factor is hand–eye coordination. The coordination of the mind, muscles, eyes, and nervous system seems to be very important since it could create an efficient pattern of movements to help the shooter's performance [23]. Furthermore, hand–eye coordination is an essential aspect related to the cleanness of the triggering and could be a differential factor between the sport levels [20,22,24]. In addition, elite shooters have a lower heart rate than beginners [25]. This heart rate is directly affected by physiological (fitness) and psychological (anxiety) factors in shooters [26]. However, a high heart-rate variability affects the autonomic nervous system, which can change the level of arousal [27] and could make participants feel more relaxed, thus improving their performance [28].

The last topic in the literature that affects shooting performance is the psychological factors. One of the most studied variables is anxiety. Anxiety levels depend on personality [2], the individual athlete's point of view [26], and used to be higher in individuals than in team sport [29]. Based on the inverted U theory, each athlete has their own optimal arousal level for performance [30]. In this line, contrary to non-experienced athletes, elite athletes increase arousal levels before a match and reduce it during competition [31]. This fact could be related to the control of emotions, stressful situations [26], and the use of coping skills for managing anxiety [29]. Specifically in shooting, high levels of anxiety involve physiological and psychological symptoms [32] which can lead to differences in firing technique and the gun's barrel movement [33]. Therefore, the improvement in physical fitness and coping strategies [29] could have direct effects on the heart rate and performance [2]. Furthermore, skills such as self-confidence, defined as an athlete's feelings and thoughts to achieve success [34], are related to coping strategies and help to cope with anxiety and negative thoughts to improve performance [26]. In this line, shooting faster could be related to more self-confidence than shooting later [35]. Conversely, excess self-confidence can have negative effects on performance [29].

Another psychological factor that modifies performance is motivation. Athletes could be motivated by internal or external reasons. These types of motivation are important for coaches in order to avoid lack of interest in training and unwanted behaviors [36], which can affect performance [37]. Thus, the shooting performance could be modified by a coach's incentives and praises, which are positively related to the satisfaction and competence of the shooters [29]. Lastly, even though there is not too much information about the effect of the types of motivation on shooting, it is known that motivation could determine athletic performance in other sports [38].

Although there is some evidence about some of the factors affecting shooting performance, there are not many reports about female pistol shooters, and some topics remain controversial. Additionally, not many studies have tried to define a complete profile (anthropometric, physiological, and psychological) according to the sport level in women's Olympic pistol shooting. Consequently, the main objective of this study is to analyse the

differences in anthropometric, physiological, and psychological variables by sport level in female air pistol shooters.

2. Materials and Methods

2.1. Participants

Fifteen female shooters participated in the study; seven were elite athletes and eight were non-elite athletes. To ensure the differences between sport levels, elite shooters were those who met three inclusion criteria: (I) have competed in international competitions, (II) are included in the Iran national team and have an official staff, and (III) have achieved at least three times the minimum score of 560–580 in the last year's national or international competitions. On the other hand, non-elite shooters require: (I) a minimum of 6 months' shooting experience, (II) no previous work with the national staff, and (III) a competition result of 500–545 during the last year. Moreover, shooters that have a disease, mental health problems, injuries, or that take illegal supplements or fail to complete all the tests were excluded from the study.

After being fully aware of the stages, benefits, and possible risks of the tests, all the participants signed an informed consent form before the data collection. The study was approved by the Baqiyatallah University of Medical Science of Iran Tehran with number: IR.BMSU.REC.1399.324.

2.2. Procedure

The selection of the variables was carried out in three steps: (I) an extensive literature review, (II) several interviews with national and international expert coaches and athletes, and (III) an analysis of the responses was made by the researchers in order to select those variables in agreement with the experts.

Variables were selected following the recommendations of the previous literature and grouped into three sections: anthropometric, physiological [39], and psychological [40–42]. Once the final variables were selected, the data collection was carried out during October–November 2020 to ensure similar seasonal conditions.

The researcher who made all the measurements was an authorized examiner of the International Society for the Advancement of Kinanthropometry (ISAK level one). To ensure reliability and measurement accuracy, this researcher performed an additional training program prior to data collection. Additionally, two more referees judged the examiner decision, and they confirmed the measurement. The attempts which had no consensus between the referees and the researcher were rejected.

2.2.1. Anthropometric Test

The anthropometric variables were measured in a single session on the shooters' training shooting ranges during their rest day, following the official criteria of the International Society for the Advancement of Kinanthropometry, by an authorized examiner. The analyzed variables were age (years), performance (point), height (cm), weight (kg) measured by a digital scale model Beurer ps07 (Beurer company, Germany, Uttenweiler), sitting height (cm), i.e., distance from the highest point on the head to the base sitting surface measured by height tape Sohehnle No.6900.00 (Sohehnle-professional, Germany, Galidor), length of the leg (cm), i.e., distance from the umbilicus to the medial malleoli of the ankle, and armspan (cm), i.e., distance from the tip of the middle finger on one hand to the tip of the middle finger on the other hand with arms abducted to 90°; both tests were measured by KDS diameter F10-02DM (Muratec-kds Corp, Japan, Kyoto).

2.2.2. Physiological Test

Regarding the physiological assessment, all tests were taken in a single session on the shooters' training shooting ranges during their rest day and repeated three times using the best record, except the Stork test, sit-ups, push-ups, and plank, in which only one attempt was registered.

The following test and protocols were done: (A) Y-test (cm): The starting position is standing on one leg at the stance plate with the toes of the foot at the red line and the other leg touching down lightly just behind the plate. The non-stance foot is reached out in the desired direction, pushing the reach indicator as far possible while maintaining balance. Attempts are made with two legs in three directions, and the maximum reach in each direction is recorded. (B) Stork test (s): Standing barefoot and with hands on hips and the heel of one foot lifted off the ground, the maximum possible time to maintain balance is measured with a time limit of one minute. As soon as the person makes a rotation or hands or heels fall off, the time will stop. (C) Sit-and-reach flexibility test (cm): While sitting on the floor with legs fully extended and the bottom of the feet against the sit-and-reach box, the maximum hands forward movement without flexing the knees is measured. (D) Alternate-Hand Wall-Toss Test (repetitions/s): Starting with the desired hand, the athlete throws the ball towards the wall and catches the ball with the opposite hand and vice versa. The shooter must try to perform the maximum number of repetitions in 30 s. (E) Resting heart rate (beats/min): Shooters are measured at rest using a pulse oximeter model Santamedical sm-519br (Santamedical, USA, Tustin). (F) Push-ups (repetitions/min): Beginning from the prone position, athletes try to raise and lower the body until their limit is achieved. (H) Sit-ups (repetitions/min): To perform valid sit-ups, athletes should go up to touch their knees and return to the starting position.

2.2.3. Psychological Test

Regarding the psychological assessment, shooters had a one-week period to complete the psychological questionnaires sent via email. The following standardized and validated questionnaires were used (see Supplementary Files S1 and S2). The SMS-6 sport motivation test; our reliability was $\alpha = 0.73$. The TSCI trait sport-confidence and SSCI state sport-confidence inventories; our reliability was $\alpha = 0.98$ for both questionnaires. The ASCI-28 athletic coping skills inventory; our reliability was $\alpha = 0.71$. The SAS sport anxiety scale; our reliability was $\alpha = 0.86$. Lastly, the sport mental toughness (SMTQ) and sport commitment model scale (SCMS) were evaluated too, but due to our reliability ($\alpha = 0.41$ and $\alpha = 0.48$, respectively), both tests were excluded from the results. Before starting to fill in the questionnaires, all tests were previously explained to the athletes.

2.3. Statistical Analysis

Variables were described by their mean (M) and standard deviation (SD). The Kolmogorov–Smirnov test and Shapiro–Wilks test were used to check the normality of the data. The independent t-test was used to determine the differences between sport levels. Additionally, the effect size (Cohen's d) was calculated with three cut-off points ($d = 0.2$ small, $d = 0.5$ medium, $d = 0.8$ large), with a 95% interval confidence. The reliability of the psychological questionnaires was calculated using Cronbach's alpha. The significance level was set at $p < 0.05$. SPSS software version 20 was used to analyze the data.

3. Results

Table 1 shows the demographic and anthropometric comparisons by sport level. The results showed that elite shooters had higher performance than non-elite shooters ($p = 0.001$; $d = 2.47$). No differences were found in the rest of the variables ($p > 0.05$).

Regarding the physiological variables, the analysis revealed that elite shooters had higher values of the Y-test left-foot back direction ($p = 0.044$; $d = -1.16$) and a higher number of sit-up repetitions ($p = 0.008$; $d = -1.63$), and lower values in the resting heart rate ($p < 0.001$; $d = 3.04$) than non-elite shooters (Table 2). No differences were found in the rest of the physiological variables ($p > 0.05$).

Regarding the psychological variables (Table 3), elite shooters had higher values of intrinsic motivation ($p = 0.031$; $d = -1.28$) than non-elite shooters. No differences were found in the rest of the variables ($p > 0.05$).

Table 1. Demographic and anthropometric differences by sport level.

Variable	Elite		Non-Elite		Effect Size			Level of Significance
	M	SD	M	SD	t	Cohen's *d*	IC-95%	*p*
Age (years)	26.29	4.11	25.63	7.42	0.209	−0.11	−1.12 to 0.90	0.838
Performance (points)	571	5.74	536	19.12	4.82	2.47	−3.82 to −1.13	0.001 *
Height (cm)	161.00	2.16	165.06	10.19	−1.029	0.55	−0.48 to 1.58	0.305
Weight (kg)	56.94	8.64	64.10	12.30	−1.284	0.67	−0.36 to 1.71	0.221
Body Mass Index (kg/cm^2)	21.95	3.17	23.62	4.65	−0.801	0.42	−0.60 to 1.44	0.437
Sitted Height (cm)	86.85	1.77	88.00	2.26	−1.075	0.56	−0.46 to 1.50	0.302
Arm Span (cm)	160.00	2.76	162.50	10.70	−0.598	0.32	−0.69 to 1.33	0.560
Leg Length (cm)	96.14	2.79	97.50	5.65	−0.574	0.30	−0.71 to 1.32	0.386
Sitted Height/Height (cm)	0.539	0.009	0.535	0.039	0.299	−0.14	−1.15 to 0.87	0.773
Sitted Height/Leg Length (cm)	0.904	0.034	0.906	0.069	−0.062	0.04	−0.97 to 1.05	0.951

Notes: Elite (n = 7) and non-elite (n = 8). M = mean; SD = Standard deviation; Cohen's d = effect size; IC-95% = Interval confidence 95%; p = significant level, significant differences are marked with *.

Table 2. Physiological characteristics and their differences by sport level.

Variable	Elite		Non-Elite		Effect Size			Level of Significance
	M	SD	M	SD	t	Cohen's *d*	IC-95%	*p*
Flexibility (cm)	37.14	7.94	39.75	7.49	−0.654	0.33	−0.68 to 1.35	0.527
Stork test (s)	1.00	0.00	0.84	0.28	1.421	−0.80	−1.86 to 0.24	0.171
Y-test Right—Right (cm)	88.57	3.77	87.12	9.20	0.387	−0.20	−1.22 to 0.80	0.705
Y-test Right—Back (cm)	83.57	11.07	75.37	6.30	1.794	−0.91	−1.97 to 0.15	0.096
Y-test Right—Left (cm)	66.85	2.67	73.75	10.93	−1.618	0.86	−0.19 to 1.92	0.130
Y-test Left—Right (cm)	81.57	4.85	76.00	8.50	1.525	−0.80	−1.85 to 0.24	0.151
Y-test Left—Back (cm)	84.28	9.75	73.13	9.44	2.248	−1.16	−2.25 to −0.06	0.044 *
Y-test Left—Left (cm)	83.85	14.28	83.37	15.98	0.061	−0.03	−1.04 to 0.98	0.952
Alternate-Hand Wall-Toss (repetitions/s)	18.85	2.79	19.75	8.37	−0.268	0.14	−0.86 to 1.15	0.793
Plank (min)	1.57	0.41	1.37	0.73	0.664	−0.33	−1.35 to 0.68	0.505
Sit-up (repetitions/s)	43.42	12.08	23.25	12.56	3.158	−1.63	−2.80 to −0.46	0.008 *
Push-up (repetitions/s)	24.28	4.49	17.50	13.15	1.295	−0.69	−1.73 to 0.35	0.218
Resting Heart Rate (Beat/min)	67.28	2.69	86.75	8.63	−5.705	3.04	1.55 to 4.53	<0.001 *

Notes: Elite (n = 7) and non-elite (n = 8). M = mean; SD = Standard deviation; Cohen's d = effect size; IC-95% = Interval confidence 95%; p = significant level, significant differences are marked with *. Y-test: two legs (right–left), three directions (right–back–left).

Table 3. Psychological characteristics and their differences by sport level.

Variable	Elite		Non-Elite		Effect Size			Level of Significance
	M	SD	M	SD	t	Cohen's *d*	IC-95%	*p*
Sport motivation	107.00	12.81	98.37	21.06	0.939	−0.49	−1.5 to 0.53	0.365
Intrinsic motivation	21.71	1.60	17.37	4.50	2.410	−1.28	−2.39 to −0.17	0.031 *
Trait sport-confidence	91.28	15.15	85.37	28.68	0.487	−0.25	−1.27 to 0.75	0.634
State sport-confidence	92.00	17.25	85.25	27.93	0.552	−0.29	−1.30 to 0.72	0.590
Sports anxiety	43.14	11.56	38.37	10.43	0.840	−0.43	−1.45 to 0.59	0.421
Athletic coping skills	56.57	5.56	56.50	12.05	0.014	0.00	−1.02 to 1.00	0.989

Notes: Elite (n = 7) and non-elite (n = 8). M = mean; SD = Standard deviation; Cohen's d = effect size; IC-95% = Interval confidence 95%; p = significant level, significant differences are marked with *.

4. Discussion

This study tried to analyze the impact of anthropometric, physiological, and psychological variables on the shooting performance by sport level. The main results of this study showed significant differences in the Y-test left—back(cm), sit-up (repetitions/s), resting heart rate (beat/min), and intrinsic motivation between elite and non-elite shooters. Thus, the pistol shooting performance of women could be influenced somehow by dynamic balance, abdominal endurance, resting heart rate, and motivation.

Regarding the anthropometric profile, finding the proper body type in the sport could lead athletes to achieve success [7]. However, our results showed no differences in the anthropometric variables between elite and non-elite shooters. These results are in accordance with the study by Mon et al. [5], who suggested that, although the weight was related to the body sway of the shooters, neither the height nor the weight had a direct effect on performance. Contrary to our previous results, BMI was related to the performance of female pistol shooters [6]. These differences could be due to the shooting levels and the number of participants (15 shooters divided between elite and non-elite groups in our study vs. 23 not divided in any groups), and the BMI values in both studies, because in the study by Mon et al. [5] the BMI data (24.63 kg/cm^2) were more similar to our non-elite participants (23.62 kg/cm^2) than to our elite shooters (21.95 kg/cm^2). Furthermore, it should be noted that the BMI measurement does not consider whether the weight is muscle or fat, so the body and its shape can be very different with a similar BMI. Accordingly, future studies could measure the fat and lean percentages or use somatocards to have more reliable anthropometric measurements [9].

In addition, contrary to other precision sports such as archery, in which the arm span could determine the performance [7], we did not find correlations between anthropometric variables and performance. Although in pistol shooting, it could be thought that the arm length could generate a greater tremor as a consequence of the kinetic chain [21], there seem to be other non-anthropometric factors that would better explain the barrel movements of the pistol, such as strength [19] or balance [13]. Therefore, in contrast to those studies that pointed out that shooters could have some specific anthropometric characteristics [3], such as being heavier and smaller than the athletes of other sports [5], our results would suggest that there is not a specific profile related to performance in women's pistol shooting and that the anthropometric factors are more efficient in combination with physical fitness [7]. Nonetheless, the knowledge of relative measures to the full body such as arm musculature or weight, or specific strengths related to the arm such as shoulder abduction or hand grip, could provide additional information on variables that could influence performance in shooting events [15].

In agreement with previous studies, our result showed that elite shooters have greater dynamic balance (left-foot back direction) than non-elite shooters, with a large effect size ($d = -1.16$). Like in other sports, most of our shooters are right-handed. In consequence, they preferably take their left foot back, similarly to our test [20]. This fact could be related to the weight distribution during aiming, as the weight is not equally distributed between the two legs, and the sport level could be a critical factor [24]. In addition, a strong postural balance could increase performance [4] by influencing accuracy and stabilization directly and indirectly [12]. Thus, the wideness of the feet position may improve balance [10] by changing the motions of the center of gravity [12], resulting in athletes with less body sway [5], enhanced aim, and, consequently, improving performance [22].

However, we did not found differences in the rest of balance variables ($p > 0.05$). This fact could be related to the importance of the static vs. dynamic balance effects on performance, with the first one being more relevant [4]. In addition, the balance effect on shooting performance seems to be related to the measurement test, being more effective in those tests similar to the shooting position [43]. Consequently, our results would suggest the need to use specific shooting tests to control the balance effect on performance. Moreover, other factors such as the participants' age or the number of elite participants could explain partially the absence of balance influence on performance [4]. On the other hand, the effect of an intervention program and specific training programs [14] seems to be a determining factor for balance and performance [16]. In this line, the reduction in trainings during the COVID pandemic has matched elite and non-elite athletes [44], which could determine the absence of differences in balance tests.

In terms of hand–eye coordination, keeping excellent pattern movements in mind helps shooters to connect the muscle and nerve system [23], which improves performance. Furthermore, coordination has a direct effect on the trigger pressure [22] and in the barrel's

movement, thus improving performance [21]. However, our result does not show significant differences between the two groups. This fact could be related to the unspecific test that was carried out, suggesting the need for more specific tests in the future.

Regarding strength, elite shooters exhibited stronger abdominal endurance than non-elite shooters, with a large effect size ($d = -1.63$). These higher strength values could contribute to better control and less tremor [6], reducing the movements of the barrel of the pistol and improving performance [21]. In contrast, upper body strength could be unimportant in shooting performance [16]. This difference in the relevance of strength in performance could be related to the use of a gender-mixed sample, which confirms the unequal performance between genders in pistol shooting [45]. Moreover, technical differences such as the number of shots (60 vs. 10 shots), the weapon (caliber vs. pellet), the shooting time, the target dimensions, or even the use of an intervention strength protocol could be reasons for the performance differences [16].

The last physiological performance-related component is heart rate. As expected, non-elite shooters had a greater resting heart rate than elite shooters with a very large effect size ($d = -3.04$). Generally, the body's fitness is directly related to the resting heart rate. In this line, elite athletes usually have better cardiovascular and respiratory fitness than non-elite. This fact is associated with thickness of the left ventricle and increase in systolic volume, which ultimately reduces the number of heartbeats [46].

Many studies agree that decreasing heart rate improves concentration and has an influence on performance because of the inverse relationship between vibration and shooting performance. Thus, the heart rate and breathing motions are linked to the body vibration [11]. However, in other shooting modalities, such as shooting performed by police officers, heart rate could be unrelated to performance [32]. Moreover, these differences could be related to the use of a national staff in their programs and the number of hours of fitness training by sport level [17], suggesting the need to have more studies on this topic.

Additionally, heart rate is related to psychological aspects such as arousal and anxiety [26]. Psychological factors such as motivation, self-confidence, and anxiety could be critical to achieve optimal levels of performance [29]. Our findings show that intrinsic motivation has a big influence on performance ($d = -1.28$). Undoubtedly, motivation is one of the most important factors in the success and efforts of athletes and can determine the athlete's maximum growth and performance [37]. Furthermore, intrinsic motivation, which indicates that an athlete does sport for joy or pleasure, has been proven to be important for performance [47]. However, although motivation is necessary, it could be insufficient for success in other endurance sports [38]. In this line, shooting may have specific motivations requirements due to its special characteristics of maximum precision [1].

Athletes often use coping skills to control themselves while competing [29]. Surprisingly, our finding did not show significant differences between the two groups in terms of anxiety, self-confidence, and coping skills. One possible explanation could be that during the COVID-19 pandemic, many competitions, including the Olympics, World Championships, and internal leagues, were canceled [48], and the number of high-pressure situations was drastically reduced during the last year. In this line, it has been reported that athletes achieved high levels of cognitive and physical anxiety and low levels of self-confidence in competition compared to training [33]. Moreover, the COVID-19 pandemic has completely changed the lives of athletes technically and psychologically [49], and although athletes should be able to perform their workouts remotely by modeling them at home in a safe environment [50], some of their training habits changed significantly. Another reason could be that, in order to avoid long periods together between the researchers and the shooters, the questionnaires were sent via email to the athletes. Therefore, the shooters completed the questionnaires without the presence of the researchers, and without pressure or anxiety, as they had one week time to answer it and a follow-up was performed with the shooters who did not respond within the timeline. In consequence, this aspect may be related to the lack of differences by sport level [51]. Additionally, the age and the

effect of experience could be related to the absence of psychological differences by level in our study [29].

Although there is not too much literature related to athletic profiling including anthropometry, physiology, and psychology of female pistol shooters and some of our results seem to be consistent with the previous studies, some limitations should be mentioned. The participant number of this study is limited and using a larger community could improve the statistical power, reduce the interval confidences of the effect size, and could confirm our results. Additionally, the use of more diverse tests, especially a specific shooting test, could add relevant information to the scientific literature. Furthermore, we cannot be sure about the effects of the pandemic data collection on our results, as our data were collected under special conditions. Lastly, even though our study could provide a base for future studies, more information is needed, particularly in the field of women's pistol shooting, specifically, in order to check the effects of special training conditions which could minimize differences by sport level in precision sports.

5. Conclusions

Our findings revealed that a variety of factors could influence shooting performance somehow, among which heart rate, abdominal strength, specific dynamic balance, and intrinsic motivation should be highlighted. However, the data collection during the pandemic period could be related to the absence of results in other variables. Accordingly, specific psychological workouts in addition to physical fitness activities could assist the athlete in reaching optimum performance. Thus, the shooting staff should include physical fitness (balance and strength) and mental programs related to motivation to improve the performance of shooters. Additionally, it is the responsibility of coaches to inform athletes of accurate, scientific information and to assist athletes in flourishing and controlling their motivation levels.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/ijerph19031102/s1. Supplementary File S1 includes five questionnaires (SAS, ACSI-28, SMS-6, TSCI, SSCI). Supplementary File S2 includes the original questionnaire in English version (SAS, ACSI-28, SMS-6, TSCI, SSCI).

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Article

Sports Level and the Personality of American Football Players in Poland

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Abstract: Research on personality in sport is very popular as it allows prediction of the behavior of players in the starting situation. Hence, verifications of players due to their sports level may turn out to be crucial. Due to the dynamic development of American football in Poland, we undertook research to verify the relationship between the sports level and the personality of these players. The Big Five personality study that we carried out involved players aged from 20 to 29—the representatives of American football clubs in Poland (N = 140) from three league games levels: LFA 1 (n = 75), LFA 2 (n = 40), and LFA 9 (n = 25). The NEO-FFI personality questionnaire was used as a research tool. The players from the top-level games were characterized by their openness to experience, the level of which decreases along with the decrease in the players' sports levels. The differences in openness to experience were revealed, first of all, in divergent thinking and creativity. It was ascertained that openness to experience is a characteristic personality trait for American football players in Poland. Therefore, systematic conduct of personality tests among American football players in Poland, in the process of selecting candidates for the highest levels of football competition, would be recommended. This might significantly affect the development of the sports level of this discipline in Poland. The obtained results of research on personality may, moreover, prove to be useful in selecting players and improving the predictions of important sports behaviors in American football in Poland.

Keywords: personality; Big Five; American football; sport level; league

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1. Introduction

American football is considered a brutal contact sport with players' collisions being an integral part of the game [1]. Interestingly enough, it is one of the few team sports in the world that allows for an attack by a player who is present on the pitch, but who is not actually taking an active part in the action. In addition, in comparison to other sports, this discipline is distinguished by above-average explosiveness and the ensuing force used during the game [2]. It should be noted, however, that American football is based on very advanced tactical arrangements. Virtually nothing that happens on the pitch can be a matter of chance. Therefore, an American football player, regardless of the sport level represented, should take care of both his proper motor and mental preparation [3]. Sometimes beginners give up further training precisely because of the lack of appropriate psychological predispositions [4]. Especially in Europe, American football players struggle with many difficulties resulting from their sports discipline in their everyday life [5]. Moreover, they have to show the right mental attitude to training and matches almost round the clock, and learn to deal with chronic pain and injuries, which are permanently inscribed in this sport discipline [6,7]. These factors show how important sport psychology and related science is for American football [8]. In this respect, research on the athletes'

personality is important, as it is determined by the athletes' environment [9,10]; hence the supposition that personality may depend on the sports level of players. Research in this area is scarce and inconsistent. On the one hand, there are no differences in the personality profiles of athletes in relation to the sport level represented [11–14]. On the other hand, such differences are present in different dimensions of their personality, depending on the trained sports discipline [15–18]. However, it is important that sport activity influences the personality of people who train. In the context of athletic performance, personality traits relate to long-term athletic success, interpersonal relationships, and the mental states of athletes before, during, and after competition. In the context of health-related exercises, personality traits refer to the use of leisure time, strength and mobility in old age, as well as unhealthy and addictive physical behaviors [6,8,10,14,16]. So far, no studies have been conducted to verify the relationship between personality and sports experience among American football players in Poland. Therefore, we decided that it is worth examining this relationship.

The first rudimentary information on American football in Poland comes from the 1990s, but the idea of creating a nationwide association of the American football movement in Poland appeared only in May 2004 [19]. Two years later, the Polish American Football League (PLFA) was established. In 2008, the competition of Polish teams was divided into two divisions. Additionally, in 2011, the third league of American football was added. Since 2013, there has been an official Polish American football representation. A further step in the development of this discipline in Poland was the establishment of the professional League of American Football (LFA), a private limited company, in 2017 at three senior levels: First League of American Football (LFA1), Second League of American Football (LFA2), Third League of Nine-men American Football (LFA9), and one junior level: the Junior League of American Football (JLFA) [20]. Currently, there are 32 teams in total in the senior leagues, and 9 teams in the junior games.

Taking the above into consideration, the aim of the present research was to verify the relationship between the sports level and the personality of American football players in Poland. For this purpose, players from all levels of the American Football League senior games existing in Poland were examined. It was decided to verify the following hypothesis: there are differences in the personality profiles of American football players in Poland, depending on the LFA games sports level.

2. Materials and Methods

With reference to the ethical approval of the study, it was conducted on the basis of positive opinion no. 20/2019 of the Senate Committee for Scientific Research Ethics at the University School of Physical Education in Wrocław, Poland.

2.1. Tested Persons

The research sample consisted of players representing 37 American football clubs in Poland, that belonged to LFA, a private limited company, in the 2020 season. These clubs play their games in the following 3 leagues: LFA 1, LFA 2, and LFA 9 (Figure 1). Participation in the study was offered to all players of the above-mentioned leagues, but only 140 footballers expressed a voluntary willingness to participate in the study and only they were included in it. The respondents were men aged from 20 to 29 and were training competitively. The players were characterized by a variety of represented physical conditions, motor skills, education (secondary or higher), and their professional background. The tested players represent all positions in the offensive and defensive formations, and therefore they are subjected to various mental and physical loads, which are characteristic for a given position on the pitch. The respondents constituted a significant cross-section of American football players aged 20–29 years in Poland.

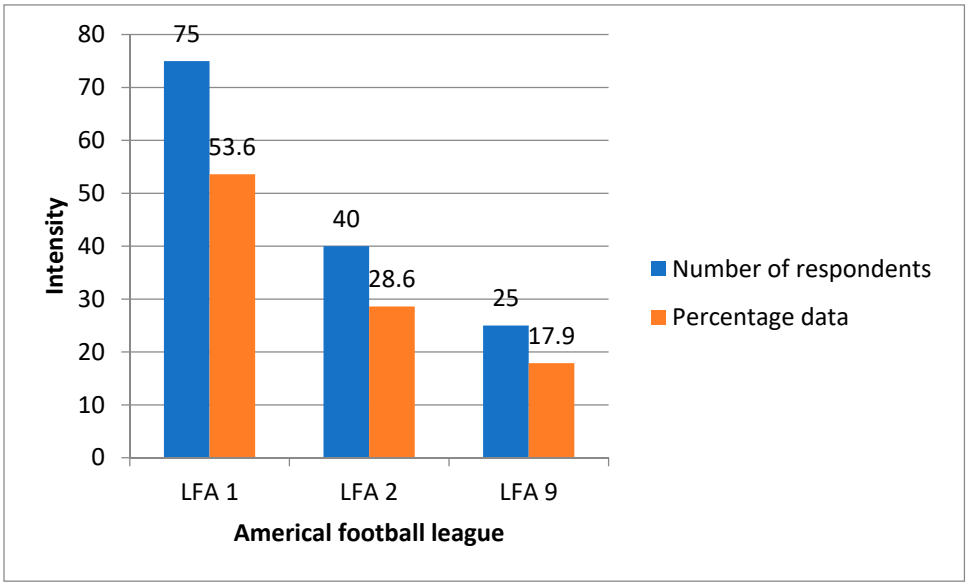

Figure 1. Division of the surveyed players according to the represented LFA game level.

2.2. Method

The study used a five-factor model of personality, known as the Big Five [21]. This model is widely recognized as the most reliable and tested theory of personality traits. According to this method, the human personality consists of 5 main characteristics and 30 subordinate ones. Personality traits, according to the above method, are the following:

- Neuroticism (anxiety, aggressive hostility, depression, impulsiveness, hypersensitivity, shyness);
- Extraversion (sociability, cordiality, assertiveness, activity, sensation seeking, positive emotionality);
- Openness to experiences (imagination, aesthetics, feelings, actions, ideas, values);
- Agreeableness (trust, straightforwardness, altruism, compassion, modesty, tendency to be sympathetic);
- Conscientiousness (competence, tendency to order, duty, striving for achievement, self-discipline, prudence).

Upon characterizing the Big Five, one should pay attention to several important aspects of the personality dimensions, namely that these features characterize the "normal personality", although their extreme intensity may contribute to the development of behavioral disorders and psychosomatic diseases. These features are not characteristic of classical personality types, and the Big Five describes mainly their extreme poles. In fact, these personality traits have a continuous nature and, like other mental properties, have a normal distribution in a population. The Big Five therefore allows a description of each personality. Moreover, these features should not be simply evaluated. A given pole may be associated not only with positive but also negative trends in behavior, both for the social environment and for a given individual. Therefore, one should not make a one-sided assessment of personality, because each of these features has its advantages and disadvantages. Additionally, that is why the Big Five factors meet the criteria required for the characteristics of the basic personality dimensions [21,22].

The research tool was the NEO-FFI Personality Questionnaire, which is widely used in personality research in the field of sports psychology [22]. The questionnaire consisted of 60 self-report statements, the truthfulness of which was assessed by the respondents themselves on a five-point scale: "definitely not", "rather not", "I have no opinion", "rather yes", "definitely yes". Due to the fact that the Big Five features contain 12 items each, the raw score for each of the features ranges from 0 to 48 points. The answer key followed a design: the higher numerical score on the scale—the greater intensity of a given feature. Thus,

the greater the number of diagnostic responses, the higher the scores on the scale of neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness—and as a result, the greater the neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness are understood as a person's characteristics. The calculation of the results of each study was performed using the tables of Polish standards for the sex and age (15–19, 20–29, 30–39, 40–49, 50–80) of the respondent. First, the raw scores were summed and then converted to sten scores. The interpretation of the results included two aspects: psychometric and psychological. Psychometric interpretation is related to presenting the results of a given player against the background of the reference group appropriate for him and assumes the necessity of interval estimation of the results. The results ranging from 1 to 3 sten should be treated as low, from 7 to 10 as high, and from 4 to 6 as average. Based on a specific profile, one may make a psychological interpretation of the obtained results.

2.3. Procedure

The research was conducted between December 2020 and February 2021. Due to the COVID-19 pandemic and the periodic lockdown in Poland, the research was conducted online. The tests were individual and were time-limited to an hour. The average time for one test was about 15 min. The research was carried out using the CAWI (Computer Assisted Web Interview) method with the use of SURVIO software for conducting surveys. Each of the American football players in Poland belonging to LFA1, LFA2, LFA9, via e-mail, received temporary access to the NEO-FFI questionnaire along with a personal request to complete it. All respondents consented to the processing of the obtained results for the purposes of scientific research. Before commencing the questionnaire, the respondents read the filling instructions.

2.4. Statistical Analyses

First, a general personality profile of American football players in Poland was generated. Then, the nature of the distribution of variables in individual groups was assessed, for which the Shapiro–Wilk test was used, and the significance level was set at $p = 0.05$. On the basis of the obtained results, adequate tests were selected for further analysis. In cases where the distribution of results in each of the groups was normal, a one-way analysis of variance ANOVA was performed. However, when the distribution in at least one group differed from the normal distribution, the Kruskal–Wallis test was used.

3. Results

Descriptive statistics of the personality profile of American football players aged 20–29 years in Poland were calculated in the first part of result analysis, as presented in Table 1.

Table 1. Values of descriptive statistics for the personality profile of American football players aged 20–29 years in Poland.

	M	SD	Min	Q25	Me	Q75	Max	Shapiro–Wilk Test (p)
Neuroticism (raw scores)	16.33	6.98	5.0	11.0	15.0	21.0	37.0	<0.001
Neuroticism (sten scores)	4.39	1.99	1.0	3.0	4.0	6.0	10.0	<0.001
Extraversion (raw scores)	33.01	7.38	14.0	29.0	34.0	39.0	46.0	<0.001
Extraversion (sten scores)	7.34	2.30	1.0	6.0	8.0	9.0	10.0	<0.001
Openness to experience (raw scores)	28.17	5.86	15.0	24.0	28.0	32.5	42.0	0.193
Openness to experience (sten scores)	5.61	1.85	1.0	4.0	6.0	7.0	10.0	0.001
Agreeableness (raw scores)	28.44	5.82	14.0	24.0	29.0	32.0	40.0	0.111
Agreeableness (sten scores)	5.61	2.12	1.0	4.0	5.0	7.0	10.0	0.001
Conscientiousness (raw scores)	34.84	7.50	15.0	30.0	36.0	41.0	48.0	0.001
Conscientiousness (sten scores)	7.09	2.22	1.0	6.0	7.0	9.0	10.0	<0.001

M—average; SD—standard deviation; Min—minimum value; Q25—lower quartile; Me—median; Q75—upper quartile; Max—maximum value; p—significance.

On the neuroticism scale, the raw scores (RS) ranged from Min = 5 to Max = 37 with the median Me = 15, and the upper quartile Q75 = 21. The distribution of the results was different from the normal distribution ($p < 0.001$). On the sten scale, the results on neuroticism ranged from Min = 1 to Max = 10. This means that the study group was quite diverse (it included both people with the lowest and the highest possible levels of neuroticism). Yet, the results of three quarters of players did not exceed the level of Q75 = 6. The distribution was different from normal ($p < 0.001$).

The raw scores (RS) on the extraversion scale ranged from Min = 14 to Max = 46, with the median Me = 34, and the upper quartile Q75 = 39. The distribution of the results differed from the normal distribution ($p < 0.001$). On the sten scale, the results on extraversion ranged from Min = 1 to Max = 10. Again, this means that the study group was quite diverse (and included both people with the lowest and the highest possible levels of extraversion). The upper quartile here was Q75 = 9 and again, the distribution was different from normal ($p < 0.001$).

On the scale of openness to experience, raw scores (RS) ranged from Min = 15 to Max = 42, with the median Me = 28, and the upper quartile Q75 = 32.5. The mean raw score for openness to experience was M = 28.17 with standard deviation SD = 5.86. The distribution of the results was normal ($p > 0.05$). On the sten scale, the results regarding openness to experience ranged from Min = 1 to Max = 10. This means that the study group was quite diverse (and included both people with the lowest and the highest possible levels of openness to experience). The upper quartile was Q75 = 7 and the distribution was different from normal ($p < 0.05$).

On the agreeableness scale the raw scores (RS) ranged from Min = 14 to Max = 40, the median was Me = 29, and the upper quartile Q75 = 32. The average for raw scores on the agreeableness scale was M = 28.44, with standard deviation SD = 5.82. The distribution of the results was normal ($p > 0.05$). On the sten scale, the results on agreeableness ranged from Min = 1 to Max = 10. This means that the study group was quite diverse (and included both people with the lowest and the highest possible levels of agreeableness). The upper quartile here was Q75 = 7 and the distribution was different from normal ($p < 0.05$).

On the conscientiousness scale, raw scores (RS) ranged from Min = 15 to Max = 48, with the median Me = 36 and upper quartile Q75 = 41. The distribution of results was different from the normal distribution ($p < 0.05$). On the sten scale, the results on conscientiousness ranged from Min = 1 to Max = 10. Yet, again, the study group turned out to be quite diverse (including both people with the lowest and the highest possible levels of conscientiousness). The upper quartile here was Q75 = 9 and the distribution was different from normal ($p < 0.001$).

In the second step of the research procedure, the personality profiles of the American football players aged 20–29 years in Poland were verified in terms of the games level. The analysis began with the assessment of the variables distribution in individual groups. For this purpose, the Shapiro–Wilk test was used; the level of significance was assumed at $p = 0.05$. Based on its results, it was decided to select the appropriate test for further analysis. One-way ANOVA was performed whenever the distribution of results was normal. On the other hand, when the distribution in at least one group differed from the normal distribution, the Kruskal–Wallis test was used. Table 2 presents the data on the personality profiles of American football players aged 20–29 years in Poland in terms of the LFA game level.

Table 2. Data on the personality profiles of American football players aged 20–29 years in Poland according to the LFA game level.

		M	SD	Min	Q25	Me	Q75	Max	Shapiro–Wilk Test Results (p)	Test Result
Neuroticism (raw scores)	LFA 1	16.79	7.11	5	12	15	21	36	0.001	H = 0.923
	LFA 2	16.00	6.91	7	11	15	19	37	0.005	df = 2
	LFA 9	15.48	6.86	6	10	14	21	34	0.090	p = 0.630
Neuroticism (sten scores)	LFA 1	4.48	2.02	1	3	4	6	10	0.006	H = 0.683
	LFA 2	4.38	1.96	2	3	4	6	10	0.007	df = 2
	LFA 9	4.12	2.01	1	2	4	6	9	0.061	p = 0.711
Extraversion (raw scores)	LFA 1	33.73	7.54	17	30	35	40	45	<0.001	H = 2.914
	LFA 2	32.83	6.80	15	30	34	38	46	0.300	df = 2
	LFA 9	31.16	7.74	14	26	33	37	44	0.160	p = 0.233
Extraversion (sten scores)	LFA 1	7.56	2.36	2	6	8	10	10	<0.001	H = 2.797
	LFA 2	7.30	2.08	2	7	8	9	10	0.004	df = 2
	LFA 9	6.72	2.44	1	5	7	9	10	0.056	p = 0.247
Openness to experience (raw scores)	LFA 1	29.29	5.45	18	26	29	33	42	0.298	F = 3.080
	LFA 2	27.03	5.56	17	24	27	30	42	0.285	df1 = 2; df2 = 137
	LFA 9	26.64	6.96	15	22	24	33	40	0.188	p = 0.049
Openness to experience (sten scores)	LFA 1	5.92	1.70	3	5	6	7	10	0.003	H = 4.850
	LFA 2	5.30	1.70	2	4	6	6	9	0.093	df = 2
	LFA 9	5.20	2.38	1	3	5	7	10	0.070	p = 0.088
Agreeableness (raw scores)	LFA 1	27.44	5.77	14	23	28	31	39	0.360	F = 2.417
	LFA 2	29.53	5.60	16	26	29	35	39	0.323	df1 = 2; df2 = 137
	LFA 9	29.68	6.00	19	25	31	33	40	0.487	p = 0.093
Agreeableness (sten scores)	LFA 1	5.28	2.07	1	4	5	7	10	0.016	H = 3.893
	LFA 2	5.98	2.13	2	5	6	8	10	0.267	df = 2
	LFA 9	6.04	2.17	3	4	6	8	10	0.064	p = 0.413
Conscientiousness (raw scores)	LFA 1	35.51	6.94	17	30	37	41	47	0.015	H = 1.363
	LFA 2	33.60	7.95	15	28	34	40	46	0.220	df = 2
	LFA 9	34.84	8.41	16	30	36	40	48	0.395	p = 0.506
Conscientiousness (sten scores)	LFA 1	7.35	2.06	2	6	8	9	10	<0.001	H = 2.343
	LFA 2	6.68	2.31	1	5	7	9	10	0.103	df = 2
	LFA 9	7.00	2.50	1	5	7	9	10	0.062	p = 0.310

M—average; SD—standard deviation; Min—minimum value; Q25—lower quartile; Me—median; Q75—upper quartile; Max—maximum value; p—significance; H—statistics of the Kruskal–Wallis test; F—ANOVA statistic; df—degrees of freedom.

There were no statistically significant differences in the raw scores on the neuroticism scale ($p > 0.05$) between players from different game levels. The result ranges in all groups differed slightly, as follows: among LFA 1 players, the results ranged from Min = 5 to Max = 36, with the lower quartile Q25 = 12, median Me = 15, and upper quartile Q75 = 21. Among LFA 2 players, the results ranged from Min = 7 to Max = 37, with the lower quartile Q25 = 11, median Me = 15, and upper quartile Q75 = 19. Among LFA 9 players, the results ranged from Min = 6 to Max = 34, with the lower quartile Q25 = 10, the median Me = 14 and the upper quartile Q75 = 21. There were no statistically significant differences in the sten scores on the neuroticism scale ($p > 0.05$) between players from different game levels. The ranges of results in all groups were comparable, as follows: among LFA 1 players the results ranged from Min = 1 to Max = 10, with the lower quartile Q25 = 3, median Me = 4, and the upper quartile Q75 = 6. Among the LFA 2 players, the results ranged from Min = 2 to Max = 10, lower quartile Q25 = 3, median Me = 4, and upper quartile Q75 = 6. Among LFA 9 players, the results ranged from Min = 1 to Max = 9, with the lower quartile Q25 = 2, the median Me = 4, and the upper quartile Q75 = 6.

There were no statistically significant differences between the different game levels players regarding the raw scores on the extraversion scale ($p > 0.05$). The ranges of results in all groups did not differ much, as follows: among LFA 1 players, the results ranged from Min = 17 to Max = 45, with the lower quartile Q25 = 30, median Me = 35, and the upper quartile Q75 = 40. Among LFA 2 players, the results ranged from Min = 15 to Max = 46, with the lower quartile Q25 = 30, median Me = 34, and upper quartile Q75 = 38. Among LFA 9 players, the results ranged from Min = 14 to Max = 44, lower quartile Q25 = 26, median Me = 33, and upper quartile Q75 = 37. There were no statistically significant differences between players of different game levels in terms of sten scores on the extraversion scale

($p > 0.05$). The ranges of results in all groups were similar: among LFA 1 players, the results ranged from Min = 2 to Max = 10, with the lower quartile Q25 = 6, median Me = 8, and the upper quartile Q75 = 10. Among LFA 2 players, the results ranged from Min = 2 to Max = 10, with the lower quartile Q25 = 7, median Me = 8, and the upper quartile Q75 = 9. Among LFA 9 players, the results ranged from Min = 1 to Max = 10, with the lower quartile Q25 = 5, median Me = 7, and the upper quartile Q75 = 9.

However, there were statistically significant differences between the different game levels players in the raw scores on the openness to experience scale (F = 3.080; df1 = 2; df2 = 137; $p < 0.05$). In the case of LFA 1 players, the results ranged from Min = 18 to Max = 42, with the median Me = 29. The mean score for raw scores in the openness to experience scale was M = 29.29, with the standard deviation SD = 5.45. In the case of LFA 2 players, the results were lower and ranged from Min = 17 to Max = 42, with the median Me = 27. The mean score for raw scores in the openness to experience scale was M = 27.03 with standard deviation SD = 5.56. LFA 9 players also had lower scores—they ranged from Min = 15 to Max = 40, with the median Me = 24. The mean raw score on the openness to experience scale was M = 26.64 with standard deviation SD = 6.96. There were no statistically significant differences in the openness to experience scale between different game levels players ($p > 0.05$). The ranges of results in all groups differed slightly, as follows: among LFA 1 players, the results ranged from Min = 3 to Max = 10, with the lower quartile Q25 = 5, median Me = 6, and the upper quartile Q75 = 7. Among LFA 2 players, the results ranged from Min = 2 to Max = 9, with the lower quartile Q25 = 4, median Me = 6, and the upper quartile Q75 = 6. Among LFA 9 players, the results ranged from Min = 1 to Max = 10, with the lower quartile Q25 = 3, median Me = 5, and the upper quartile Q75 = 7.

There were no statistically significant differences between the different game levels players in the agreeableness scale (F = 2.417; df1 = 2; df2 = 137; $p > 0.05$). The ranges of scores in all groups were similar, as follows: among LFA 1 players, the scores ranged from Min = 14 to Max = 39, with the median Me = 28. The mean score for the raw scores on the agreeableness scale was M = 27.44 with standard deviation SD = 5.77. Among LFA 2 players, the results ranged from Min = 16 to Max = 39, with the median Me = 29. The mean score for raw scores on the agreeableness scale was M = 29.53 with standard deviation SD = 5.60. Among the LFA 9 players, the results ranged from Min = 19 to Max = 40, and the median was Me = 31. The mean score for raw scores on the agreeableness scale was M = 29.68 with standard deviation SD = 6.00. There were no statistically significant differences in the sten scores on the agreeableness scale ($p > 0.05$) between the different game levels players. The ranges of results in all groups were slightly different; however, among LFA 1 players, the results ranged from Min = 1 to Max = 10, with the lower quartile Q25 = 4, median Me = 5, and the upper quartile Q75 = 7. Among LFA 2 players, the results ranged from Min = 2 to Max = 10, with the lower quartile Q25 = 5, median Me = 6, and the upper quartile Q75 = 8. Among LFA 9 players, the results ranged from Min = 3 to Max = 10, with the lower quartile Q25 = 4, median Me = 6, and the upper quartile Q75 = 8.

There were no statistically significant differences between the different game level players regarding the raw scores on the conscientiousness scale ($p > 0.05$). The range of results in all groups was slightly different, as follows: among LFA 1 players the results ranged from Min = 17 to Max = 47, with the lower quartile Q25 = 30, median Me = 37, and the upper quartile Q75 = 41. Among LFA 2 players, the results ranged from Min = 15 to Max = 46, with the lower quartile Q25 = 28, median Me = 34, and the upper quartile Q75 = 40. Among LFA 9 players, the results ranged from Min = 16 to Max = 48, with the lower quartile Q25 = 30, median Me = 36, and the upper quartile Q75 = 40. There were no statistically significant differences in the sten scores on the conscientiousness scale between different game levels players ($p > 0.05$). The ranges of results in all groups were comparable, as follows: among LFA 1 players, the results ranged from Min = 2 to Max = 10, with the lower quartile Q25 = 6, median Me = 8, and the upper quartile Q75 = 9. Among LFA 2

and LFA 9 players, the results ranged from Min = 1 to Max = 10, with the lower quartile Q25 = 5, median Me = 7, and the upper quartile Q75 = 9.

4. Discussion

In our study, we managed to reach the research goal, which was to verify the relationship between the sports level and the personality of American football players in Poland. The research hypothesis has been verified positively—there are differences in the personality profiles of American football players in Poland depending on the sports level of the LFA games. It was first necessary to determine what level of sports advancement each person from the research group represented. This assessment was carried out subjectively on the basis of many years of observation of American football in Poland, as well as excellent knowledge of the discipline environment. The LFA 1 League, being the highest class of the game in Poland (as of late 2020), brings together by far the best teams, whose players, compared with LFA 2 and LFA 9, were characterized by significantly better motor, technical, and tactical preparation. It should be noted that in the event of creating the Polish national team, the players of the three best LFA 1 teams in the 2020 season would be the backbone of the list appointed to represent the Polish national colors. In recent years, the LFA 2 has had a much lower overall sports level than the LFA 1. Despite the fact that in the second league there were some above average players, the average level of football and athletic advancement was visibly lower. LFA 9, on the other hand, is a league that exists for newly established and developing teams that are not able to gather the full team needed to play 11-person football, or teams that do not have enough capital to cope with this challenge. On average, this league includes players whose football and motor advancement is definitely weaker than at the first two game levels in Poland. It should be noted that, in the event of promotion or transfer to a higher league of American football, the club that was a newcomer in the first year of games, most often visibly deviated from the overall level, to the detriment of rivals from a given league. A similar situation occurred with the relegation, where the club joining the league definitely stood out from the rest. Based on the analysis of the conducted research results, there exist statistically significant differences in the raw scores on the openness to experience scale ($F = 3.080$; $df1 = 2$; $df2 = 137$; $p < 0.05$) between players of different game levels. In the case of LFA 1 players, the mean score on the openness to experience scale was M = 29.29 with the standard deviation SD = 5.45. In the case of LFA 2 players, the average results were lower and amounted to M = 27.03 with the standard deviation SD = 5.56. However, in the case of LFA 9 players, lower scores were also observed, which gave an overall result of M = 26.64 with a standard deviation of SD = 6.96. This means that the highest game level players are characterized by the greatest openness to experience, the level of which decreases with the sports level. This, in turn, may imply that the sport level represented has an influence on the American football player's personality in Poland. The research hypothesis has been partially positively verified—there are differences in the personality profiles of American football players in Poland depending on the sports level of the LFA games, namely: the differences exist only in the dimension of openness to experience. It is worth mentioning that people with a higher openness to experience are more interested in both the external and internal world. They show greater creativity and a vivid and creative imagination. In addition, they often feel intellectual curiosity and interest in art. At the same time, they are unconventional, prone to questioning authority, independent in judgment, and focused on discovering new ideas. On the other hand, people with lower openness to experiences are characterized by more conventional behavior, as well as conservatism in views. Recognizing traditional values and having pragmatic interests, they prefer commonly accepted ways of doing things. Hence, the supposition that the differences in openness to experience were revealed primarily in divergent thinking and creativity of American football players in Poland [21,22]. Therefore, in our opinion, American football players in Poland, characterized by the highest level of openness to experience, have the greatest personality potential to achieve championship at the national level in the

long run. Moreover, the research results clearly show that the identification of the players' personality traits, not only in the selection process, is very important. By discovering the features of players, the coaches can significantly improve the process of recruiting potential players, but also, to some extent, minimize the risk of recruitment failure. Moreover, the coaches, knowing the personality traits of their players, are able to influence them during matches more easily and consciously.

However, the important thing is that no statistically significant difference was found in the openness to experience and other personality dimensions as a result of the sten score. This means that there are no differences in the interpretation of American football players personality depending on the sports level. American football players from the studied leagues are characterized by high extraversion and conscientiousness as well as average neuroticism, openness to experience, and agreeableness, i.e., the personality profile of a typical athlete. The obtained results confirm previous studies between the personality and the sports level of Polish volleyball players [23] and emphasize the role of sport in shaping the personality [24]. Sports activity shapes the personality and the shaped personality traits have an impact on taking solutions in the starting situation [25]. It should be associated with the specificity of sports rivalry and slightly different psychological requirements that sports disciplines impose on competitors. Therefore, among American football players in Poland, there was a significant difference in openness to experience, and among Polish volleyball players, there were significant differences in neuroticism, extraversion, and conscientiousness. However, generally, athletes are distinguished from non-training people by high extraversion, which characterizes their social interactions, their dimensions, quality, their level of energy and activity [11,17,26–31], and their conscientiousness—a dimension that distinguishes the level of organization, persistence, and motivation of an individual in pursuing a goal [32–34]. Additionally, champions are additionally distinguished by low neuroticism, which reflects emotional adjustment versus emotional imbalance [10,13,18,35–42]. Additionally, the dimensions of openness to the experiences (describes the human tendency to seek and try new things, not being afraid of adventures, looking for new unconventional solutions) and agreeableness (the dimension characterized by positive attitudes towards others versus negative attitudes—being ready to sacrifice oneself for another person versus aversion and putting one's own interests over others) of athletes are similar to those of non-training people [43–47].

In summary, we have proved a difference between sports level and personality in the raw score in openness to experience at the level of 0.049. The lack of such a difference in the sten score (openness to experience is at the same level of interpretation) indicates the specificity of American football. The obtained data confirm the significant impact of American football and its level on the shaping of the researched players' personality. Sport activity (American football) shapes the players' personality, and this is visible in the sten result—there is no difference in the obtained personality profiles. In turn, the shaped personality traits have an impact on making decisions in the starting situation at a given sports level, and this is visible as a raw result in the dimension of openness to experience. This is related to the specificity of sports rivalry in American football and slightly different psychological requirements that the players in the LFA 1, LFA 2, and LFA 9 leagues have.

In American football, we deal with a huge variety of tasks and sports techniques used. In addition, this sport is characterized by the accumulation of players with different personality profiles, which is why it was so important to generate personality profiles of American football players in Poland. It should be mentioned that similar studies were carried out in the homeland of American football, i.e., the United States. Schaubhut et al. [48] presented the results of the CPI 260^{TM} on 812 players who, in the years 2002–2005, applied for a professional contract in the best American football leagues in the world. It was shown that out of the studied group of quarterbacks, running backs, wide receivers, linebackers, kickers/punters, defensive backs, and defensive tackles, quarterbacks (QB) score higher on average than others on scales such as domination, independence, good impression, and leadership. In contrast, defensive players scored significantly lower than others on

scales such as self-acceptance, social compliance, achievement through compliance, and work orientation. Interestingly, a comparison was also made between the group of players who, despite participating in the recruitment, did not receive an offer to play in any of the leagues, and the group of qualified footballers. The obtained results were remarkably similar to each other; however, the selected persons obtained, on average, slightly higher results on the self-control scale. Both research studies clearly showed how important it is to define personality in the recruitment of players to American football, which is aimed at acquiring players with the greatest sports potential that can be used in the long term [11]. In addition, we find it necessary to conduct further research on the relationship between personality and sports experience in all sports disciplines.

5. Conclusions

To summarize, openness to experience is a characteristic personality trait for American football players in Poland. Raw scores on this scale were the only ones that showed statistically significant differences between players representing the LFA 1, LFA 2, and LFA 9 league levels. It is recommended thus to systematically conduct personality tests among American football players in Poland in the process of recruiting candidates for football competition at the highest level. It can significantly contribute to a more accurate recruitment of players, and will also accelerate the development of the sports level of this discipline in Poland. In addition, the results of personality studies may prove useful in improving the predictions of important sporting behavior in American football, such as: individual results, reactions to failure, and long-term achievements. It should be noted that the sten results of American football players in Poland are at an average level, as are the data of Polish non-training persons. We assume that this proves the uniqueness of American football as a sports discipline for everyone. The raw results, on the other hand, show the influence of the level of the games on the shaping of the personality of American football players in Poland.

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Perfectionism, Mood States, and Choking in Asian University Baseball Players under Pressure during a Game

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Abstract: The purpose of this study was to investigate relationships among mood states, perfectionism, and choking, and to identify a mediating effect of perfectionism on the relationship between mood states and choking experienced by Asian university baseball players in extremely stressful situations during a game. Data collected from a total of 209 male university baseball players were analyzed using SPSS 21 and AMOS 21 statistical software. The mean age of study subjects was 20.25 years. Results are as follows. First, mood states had a positive influence on perfectionism. Second, mood states had no significant influence on choking. Third, perfectionism had a positive influence on choking. Lastly, perfectionism had a complete mediating effect on the relationship between mood states and choking. The study findings will provide basic data to relieve athletes' psychological burdens, and prevent manifestations of extreme perfectionism and choking, which can ultimately help athletes maintain high self-control of their mood states and perfectionism for better performance.

Keywords: baseball; university baseball players; mood states; choking; perfectionism; mediating effect

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1. Introduction

Baseball is a highly popular elite and leisure sport in Korea and Japan [1]. Baseball requires high concentration over long periods during play, and players can only perform well when they are physically and mentally healthy; findings indicate correlations between baseball players' mood states and their performance during a game [2,3].

For Asian university baseball players, every game is an audition for any possible scouts for potential professional players, and exceptional athletic capability during every game is critical in determining amateur players' future career paths [4]. Advancement to a professional league is the goal of every university baseball player, and the pressure can have varying impacts on their mood states during games [5].

Players frequently experience negative moods, such as tension and confusion, when they set high standards they do not believe they can meet, or when they think others believe they cannot meet them [5,6]. Such negative mood states have detrimental influence on athletes themselves, and their relationships with colleagues, coaches, and parents [6]. Accordingly, it can be said that a multidimensional approach to understanding how moods manifest in performance during competition can provide very important perspectives [7].

In this direction, sports psychologists confirm that mood states influence performance in competitive environments such as sports [8–10]. Amateur athletes face constant pressure to achieve professional status, and this extreme focus can trigger potentially disruptive perfectionism; perfectionism, in turn, affects goal achievement, motivations, and motor performance [11]. Therefore, understanding perfectionism in university athletes plays an important role in explaining its adaptive (positive) traits, such as improving athletic skills,

boosting motivation, and enhancing performance, as well as its more maladaptive aspects, such as lower self-confidence and poorer performance [12,13].

However, athletes experience choking under pressure in a competitive environment [14]. The choking is defined as 'showing inferior performance even in the situation where rewards are given for performance at the highest level' [15] or 'dramatic performance decline' occurring in stressful situations [16–19]. In prior research, athletes who often face performance pressure have vivid feelings on the phenomenon and fear of choking under pressure [5,20], and skill decrements under pressure include not just simple poor performance, but also a form of paralysis that can cause athletes to perform worse than they are actually capable of [15,20]. Hall [21] found that athletes have quite individual and subjective perceptions regarding the phenomenon of choking under pressure. However, there is still a lack of sophisticated understanding about the performance failure phenomenon of choking under pressure under critical situations [22,23]

Researchers propose two representative mechanisms to explain choking, distraction theory and explicit monitoring (or self-focus) theory [14,24]. In distraction theory, the pressure during execution can increase self-awareness, which increases attention to executing a skilled performance. On the contrary, the crux of explicit monitoring theory is how performers can control their own mood states and attention in high-pressure situations [14]. Opinions differ on which of these two theories better explains the choking phenomenon, and studies are needed on choking in different tasks contexts, as well as according to skill level, individual mood, and sensitivities to perfectionism. Results from such research should provide useful knowledge to help athletes and coaches train to overcome the choking that can occur in pressure situations.

Toward the aim of offering clearer data on the phenomenon of choking among university athletes, the purpose of this study was to empirically investigate relationships among mood states, perfectionism, and choking, and to identify any mediating effect of perfectionism on the relationship between mood states and choking in Asian university baseball players in high-pressure game situations. We investigated these relationships by testing the following hypotheses.

Hypothesis 1 (H1). *Mood states in extremely stressful situations affect perfectionism ($p < 0.05$).*

Hypothesis 2 (H2). *Mood states in extremely stressful situations affect choking ($p < 0.05$).*

Hypothesis 3 (H3). *Perfectionism in extremely stressful situations affects choking ($p < 0.05$).*

Hypothesis 4 (H4). *Perfectionism in extremely stressful situations has a mediating effect on the relationship between mood states and choking ($p < 0.05$).*

2. Materials and Methods

2.1. Participants

Convenience sampling method was used to select 223 baseball players that were enrolled at universities in Korea and Japan in the period between November 2019 and February 2020 for data collection. We administered to the students a survey that had been originally written in Korean, and translated into Japanese; a specialized translation company certified the accuracy of the Japanese translation against the original document. The Ethics Committee of Nippon Sports Science University approved this study (019-H132).

Before signing the written consent, all selected university baseball players were briefed on the scope and objectives of the study, then they completed the questionnaires during their free time. Between ten and twenty participants were engaged in each survey session, in a process that cumulatively collected data from a total of 223 baseball players. The average time to complete the questionnaire per session was approximately 30 min, with 10 min for the students to give their own oral definitions of the phenomenon of choking, and 20 min to complete the questionnaires. We offered during each session to answer any questions the athletes had about survey content, and we reconfirmed that their participation

in the study was voluntary. After we excluded 14 participants whose surveys indicated that they had never experienced choking during a pressure situation, 209 survey responses remained for analysis. Table 1 presents the general characteristics of these 209 subjects.

Table 1. Characteristics of participants (n = 209).

Variable	Division	n	%
Gender	Male	209	100
Nationality	Korean	61	29
	Japanese	148	71
Grade	Freshman	68	32.5
	Sophomore	58	27.8
	Junior	45	21.5
	Senior	38	18.2
	Average age (years)	209	20.25
Position	Pitcher	139	66.5
	Fielder	70	33.5
Period	Baseball career(years)	209	12.1
	Pitcher career(years)	139	5.6

2.2. Data Processing

For the questionnaire in this study, survey respondents rated each item on a 5-point Likert scale ranging from 1 (*I strongly disagree*) to 5 (*I strongly agree*); except the demographic characteristics, Table 2 presents the survey items. We analyzed the collected data using SPSS 21 (IBM, Armonk, NY, USA) and AMOS 21 (IBM, Chicago, IL, USA) in accordance with the following procedure to ensure survey validity and reliability. First, we conducted frequency analysis of the students' general demographic characteristics (i.e., background variables). Second, survey content validity had been evaluated before the study commenced by a consultation committee of three experts with PhDs in physical education. Third, we conducted confirmatory factor analysis (CFA) to calculate the construct validity of the survey, and calculated reliability though internal consistency estimation (Cronbach's α coefficient) for a derived subfactors. We tested convergent validity using average variance extracted (AVE) and construct reliability (CR) coefficients, where convergent validity is established if AVE is 0.5 or higher, and CR is 0.7 or higher [25].

Table 2. Contents of the questionnaire.

Variables	Index	Question	Total
Background Variables	General characteristics	Gender (1) Nationality (1) Grade (1) Position (1) Period (2)	6
Independent Variables	Mood states	Confusion (4) Tension (3) Vigor (4)	11
Mediating Variables	Perfectionism	Other-oriented (5) Socially prescribed (4) Self-oriented (3)	12
Dependent Variables	Choking	Anxiety-related thinking (3) Self-focusing and motor control (3) Cognitive, emotional, and perceptual confusion (4)	10
Total			39

Fourth, we conducted Pearson's correlation analysis to analyze the relationships between subfactors before testing the hypotheses ($p < 0.01$); the relationship between two subfactors is considered strong when r is 0.7 or higher. Fifth, we ran structural equation modeling (SEM) to test the study hypotheses. According to previous researchers, SEM requires establishing clear interpretation criteria for research model goodness-of-fit considering model parsimony and sensitivity to sample size [25–27]. To this end, Kline [28], Hooper, Coughlan, and Mullen [29], No [25], and Kim et al. [27] established the following criteria as indicating good model fit: SRMR (standardized root mean square residual) = 0.08 or less, IFI (incremental fit index), TLI (Tucker–Lewis index), CFI (comparative fit index) = 0.9 or higher, and RMSEA (root mean square error of approximation) = 0.1 or less. Lastly, we tested goodness-of-fit of the complete mediating model, and performed bootstrapping analysis to investigate the mediating effect of perfectionism on the relationship between mood states and choking.

2.3. Extremely Stressful Situations

To help subjects fully understand how we intended "extremely stressful situations", we spent approximately 10 min discussing the concept with the student athletes in each session before they filled out their questionnaires. "Extremely stressful situations" refers to sudden and abnormal changes in mood states during a game that cause athletes to either underperform or concentrate more intensely. For instance, the bottom of the ninth inning with bases loaded and a score of 3–2 is a critical moment when the losing team's pitchers, batters, and fielders should perform to the best of their ability. For this study, we identified three or four potential extremely stressful situations that could occur during a game, and described them in detail to the participants. In addition to the oral instruction, the front page of the questionnaire also bore a detailed description of extremely stressful situations, in order to ensure all subjects were fully aware of the definition before participating in the survey.

3. Results

3.1. Descriptive Statistics

Overall, 209 baseball players from Asian universities (148 Japanese and 61 Koreans) were enrolled in the study. The mean age was 20.25 years, mean career duration was 12.1 years, whereas the pitchers' mean career duration was 5.6 years.

3.2. Mood States

We measured the athletes' mood states using Park's [30] modified version of the Profile of Mood States (POMS), which had been revised from the original by McNair, Lorr, and Droppleman [31]. As Table 2 shows, mood states were measured with a total of 11 questions in 3 subfactors: 4 for confusion; 3 for tension; and 4 for vigor. Table 3 and Figure 1 display the CFA results.

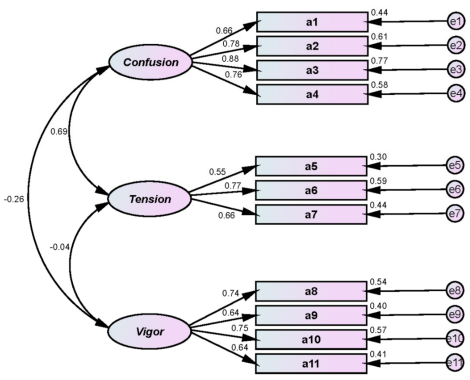

Figure 1. Mood states CFA.

Table 3. Validity and reliability analyses.

Variables		Item	λ	S.E.	C.R.(t)	*p*	SC	AVE	C.R.	α
Mood states	confusion	a1. distracted	1.000				0.660	0.578	0.938	0.877
		a2. woozy	1.122	0.118	9.537	0.001	0.780			
		a3. perplexed	1.435	0.139	10.302	0.001	0.880			
		a4. uncertain	1.134	0.122	9.330	0.001	0.758			
	tension	a5. nervous	1.000				0.548	0.618	0.829	0.894
		a6. agitated	1.445	0.219	6.607	0.001	0.767			
		a7. restless	1.344	0.212	6.330	0.001	0.664			
	vigor	a8. energetic	1.000				0.736	0.550	0.829	0.874
		a9. active	0.978	0.125	7.821	0.001	0.636			
		a10. lively	1.047	0.120	8.755	0.001	0.753			
		a11. cheerful	0.975	0.124	7.838	0.001	0.638			
χ^2 = 95.788, df = 41, p = 0.001, SRMR = 0.066, IFI = 0.935, TLI = 0.912, CFI = 0.934, RMSEA = 0.080										
Perfectionism	other-oriented	b1. People around me expect more than what I am capable of	1.000				0.765	0.555	0.833	0.872
		b2. People around me expect me to be perfect	1.203	0.098	12.237	0.001	0.839			
		b3. My family expect me to be perfect	1.244	0.108	11.563	0.001	0.795			
		b4. People around me expect too much from me	1.104	0.097	11.418	0.001	0.783			
	socially prescribed	b5. People around me will like me when I excel in sports and everything	1.000				0.819	0.559	0.792	0.812
		b6. People around me would think of me as a nice person only if I am successful	1.020	0.092	11.086	0.001	0.802			
		b7. People around me would think of me as competent only if I don't make a mistake	0.817	0.086	9.450	0.001	0.670			
	self-oriented	b8. I try to be as perfect as possible	1.000				0.691	0.535	0.851	0.873
		b9. It is important for me to be perfect in everything	1.004	0.107	9.359	0.001	0.711			
		b10. I want myself to be perfect	1.447	0.129	11.229	0.001	0.884			
		b11. I have a strong desire to become perfect	1.393	0.136	10.216	0.001	0.783			
		b12. My goal is to be perfect in everything	1.404	0.142	9.853	0.001	0.752			
χ^2 = 126.008, df = 50, p = 0.001, SRMR = 0.060, IFI = 0.944, TLI = 0.926, CFI = 0.944, RMSEA = 0.085										
Choking	anxiety-related thinking	c1. I was concerned about how other people think of me	1.000				0.765	0.682	0.865	0.870
		c2. I couldn't shake off a mistake and kept thinking of it	1.062	0.087	12.155	0.001	0.818			
		c3. I was worried about and afraid of disappointing other people	1.265	0.096	13.235	0.001	0.909			
	self-focusing and motor control	c4. My decision-making ability was worse than normal due to high pressure	1.000				0.853	0.707	0.879	0.896
		c5. I moved impatiently	1.034	0.064	16.122	0.001	0.893			
		c6. My movement was stiff and not soft	0.983	0.066	14.902	0.001	0.842			
	cognitive, emotional, and perceptual confusion	c7. I felt as if all people watched only me	1.000				0.713	0.595	0.854	0.874
		c8. I became more conscious of the surrounding environment than usual	1.067	0.096	11.139	0.001	0.824			
		c9. I thought that things around me and the environment were against me	1.144	0.106	10.798	0.001	0.797			
		c10. I was engulfed by the atmosphere	1.096	0.096	11.461	0.001	0.851			
χ^2 = 93.005, df = 32, p = 0.001, SRMR = 0.047, IFI = 0.957, TLI = 0.939, CFI = 0.957, RMSEA = 0.096										

First, all indexes indicated adequate goodness-of-fit: χ^2(df) = 95.788(41)/p < 0.001; SRMR = 0.066; IFI = 0.935; TLI = 0.912; CFI = 0.934; RMSEA = 0.080. Second, survey reliability was confirmed: Cronbach's α = 0.877 for confusion; 0.894 for tension; and 0.874 for vigor. Third, CR and AVE findings confirmed the convergent validity of the survey tool: CR = 0.938 for confusion; 0.829 for tension; and 0.829 for vigor; and AVE = 0.578 for confusion; 0.618 for tension; and 0.550 for vigor.

3.3. Perfectionism

We measured perfectionism using Kim's [12] modified version of the Multi-dimensional Perfectionism Scale (MPS), originally developed by Hewitt and Flett [32] to investigate perfectionism in university rugby players. Table 2 shows that the perfectionism scale comprised 12 questions in 3 subfactors: 4 for other-oriented; 3 for socially prescribed; and 5 for self-oriented. Table 3 and Figure 2 display the CFA results.

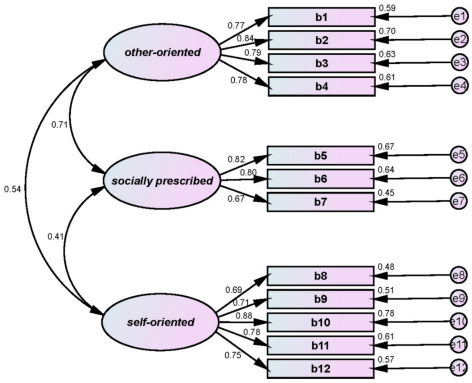

Figure 2. Perfectionism CFA.

First, all indexes met the goodness-of-fit requirements: χ^2(df) = 126.008(50)/p < 0.001; SRMR = 0.060; IFI = 0.944; TLI = 0.926; CFI = 0.944; RMSEA = 0.085. Second, reliability of the survey tool was confirmed: Cronbach's α = 0.872 for other-oriented; 0.812 for socially prescribed; and 0.873 for self-oriented. Third, CR and AVE results confirmed convergent validity: CR = 0.833 for other-oriented; 0.792 for socially prescribed; and 0.851 for self-oriented; and AVE = 0.555 for other-oriented; 0.559 for socially prescribed; and 0.535 for self-oriented.

3.4. Choking

We investigated choking among the student athletes using Park's [5] modification of Murayama and Sekiya's [33] original 77-question choking scale. Table 2 shows that choking was measured with 10 questions on 3 subfactors: 3 for anxiety-related accidents; 3 for self-focus and motor control; and 4 for cognitive, emotional, and perceptual confusion.

First, we conducted CFA to verify the construct validity of the scale, and results are shown in Table 3 and Figure 3; all indexes met goodness-of-fit requirements: χ^2(df) = 93.005(32)/p < 0.001; SRMR = 0.047; IFI = 0.957; TLI = 0.939; CFI = 0.957; RMSEA = 0.096. Second, reliability was confirmed: Cronbach's α = 0.870 for anxiety-related thinking; 0.896 for self-focusing and motor control; and 0.874 for cognitive, emotional, and perceptual confusion. Third, CR and AVE results confirmed convergent validity: CR = 0.865 for anxiety-related thinking; 0.879 for self-focusing and motor control; and 0.854 for cognitive, emotional, and perceptual confusion; and AVE = 0.682 for anxiety-related thinking; 0.707 for self-focusing and motor control; and 0.595 for cognitive, emotional, and perceptual confusion.

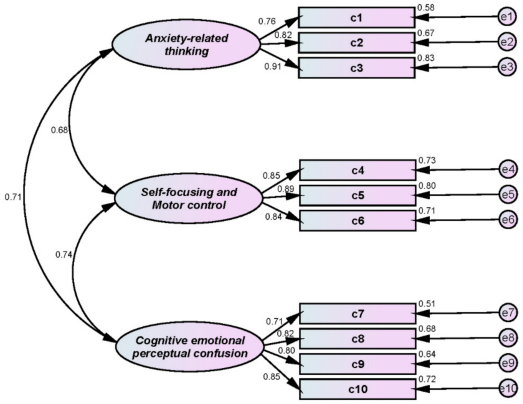

Figure 3. Choking CFA.

3.5. Pearson's Correlation Analysis

Table 4 presents the Pearson's correlations for the study constructs. First, confusion, a mood state subfactor, showed statistically significant positive correlations with other-oriented and socially prescribed subfactors of perfectionism (r = 0.406 and 0.387, respectively; $p < 0.01$). Tension, another mood state subfactor, also showed a significant positive correlation with the other-oriented perfectionism subfactor (r = 0.216; $p < 0.01$). Second, tension also had significant positive correlations with all subfactors of choking (r = 0.272, 0.191, and 0.230; all $p < 0.01$). Lastly, the other-oriented perfectionism subfactor showed statistically significant positive correlations with all choking subfactors (r = 0.304, 0.202, and 0.296; all $p < 0.01$). The self-oriented perfectionism subfactor also had significant positive correlations with the choking subfactors of anxiety-related thinking and cognitive, emotional, and perceptual confusion (r = 0.183 and 0.259, respectively; $p < 0.01$). In a preceding study, Kline [28] determined that a correlation coefficient between subfactors of 0.85 or less indicates that there is no multicollinearity between subfactors. Based on this criterion, there was no multicollinearity between subfactors: r = −0.216 to 0.638. Table 5 presents the overall goodness-of-fit findings for the study model, and, below, we discuss the findings for the hypothesis testing.

Table 4. Pearson's correlations among mood states, perfectionism, and choking.

Variables	Subfactors	1	2	3	4	5	6	7	8	9
Mood states	confusion (1)	1								
	tension (2)	0.519 **	1							
	vigor (3)	−0.216 **	−0.012	1						
Perfectionism	other-oriented (4)	0.406 **	0.216 **	0.002	1					
	socially prescribed (5)	0.387 **	0.096	−0.016	0.597 **	1				
	self-oriented (6)	0.054	0.072	0.008	0.464 **	0.345 **	1			
Choking	anxiety-related thinking (7)	0.101	0.272 **	−0.019	0.304 **	0.021	0.183 **	1		
	self-focusing and motor control (8)	0.087	0.191 **	0.032	0.202 **	0.088	0.131	0.600 **	1	
	cognitive, emotional, and perceptual confusion (9)	0.117	0.230 **	0.047	0.296 **	0.098	0.259 **	0.620 **	0.638 **	1

** $p < 0.01$.

Table 5. Path analysis and fit index of the research model.

H	Path			Estimate	S.E.	C.R(t)	Sig.	Result
H1	Mood states	→	Perfectionism	0.111	0.054	20.059	0.039	Accept
H2	Mood states	→	Choking	−0.031	0.032	−0.971	0.332	Reject
H3	Perfectionism	→	Choking	0.538	0.141	30.808	0.001	Accept
Fit Index	χ^2(df) = 56.195(23)/p = 0.001, SRMR = 0.071, IFI = 0.940, TLI = 0.904, CFI = 0.939, RMSEA = 0.083							

3.6. Hypothesis Testing

With this study, we aimed to investigate relationships among mood states, perfectionism, and choking among a group of male university baseball students from Korea and Japan in moments of what we called extremely stressful situations during games. We also were aiming to identify a mediating effect of perfectionism on the relationship between mood states and choking. We tested the hypotheses using SEM analysis, and Table 5 shows these results.

First, analysis of the relationship between mood states and perfectionism showed that mood states had a statistically significant positive influence on perfectionism with a path coefficient of 0.111 (t = 2.059, $p < 0.05$). Therefore, H1 was accepted. Second, analysis of the relationship between mood states and choking revealed no significant influence of mood states on choking, with a path coefficient of −0.031 (t = −0.971). Therefore, H2 was rejected. Third, analysis of the relationship between perfectionism and choking revealed a significant positive influence of perfectionism on choking, with a path coefficient of 0.538 (t = 3.808, $p < 0.01$). Therefore, H3 was accepted.

We also analyzed goodness-of-fit of the complete mediation model, and conducted bootstrapping to analyze the mediating effect of perfectionism on the relationship between mood states and choking. Table 6 shows that the complete mediation model met the goodness-of-fit requirements: χ^2(df) = 57.290(24)/p = 0.001; SRMR = 0.066; IFI = 0.940; TLI = 0.908; CFI = 0.938; RMSEA = 0.082. Bae [26] established that if the difference between an incomplete and a complete mediation model is χ^2= 3.84 or less at α = 0.05, and the degree of freedom is 1 or less, mediation is complete. Because the difference between the two models here was estimated at $\Delta\chi^2$ = 1.095 and Δdf = 1, complete mediation (indirect effect) was confirmed. To verify the significance of an indirect effect, we conducted bootstrapping with a repetition frequency of 2000 times, and a bias-corrected confidence interval of 95%, and the results showed a statistically significant (complete) mediation effect at p = 0.001. That is, perfectionism had a complete mediating effect on the relationship between mood states and choking, and H4 was accepted.

Table 6. Mediating effect analysis through bootstrapping.

Path				Bootstrap Estimates 95% Confidence Interval					
				Indirect Effect		Lower		Upper	
Mood states	→	Perfectionism	→ Choking	0.001		0.040		0.234	
Model		χ^2	df	p	SRMR	IFI	TLI	CFI	RMSEA
Complete mediation		57.290	24	0.001	0.066	0.940	0.908	0.938	0.082

$\Delta\chi^2$ = 1.095, Δdf = 1.

4. Discussion

The purpose of the present study was to investigate relationships among mood states, perfectionism, and choking perceived by Asian university baseball players in extremely stressful situations during a game, and identify the mediating effect of perfectionism on the relationship between mood states and choking. Below, we present a discussion of our findings.

First, mood states had a positive effect on perfectionism. Sports inevitably involve competition, which triggers a wide range of mood states in athletes, and researchers have studied mood states to predict athletes' behaviors, tendencies, and performance [34]. In addition, mood is an important factor to improve athletes' motor performance ability, as well as their athletic performance [35,36]. We confirmed the influence of mood states on perfectionism in the present study consistent with preceding studies regarding the relationship between mood states and behavior tendencies.

For instance, researchers have identified perfectionism as a behavior tendency with both positive and negative impacts [37–42], and here, we determine that mood states can determine a perfectionist personality. The double-edged sword of perfectionism is associated with motor performance ability with documented positive and negative impacts [40,43]. When this personality tendency trends toward the positive, perfectionism shows positive, rather than negative, impacts on motor performance ability. Follow-up researchers could investigate the impacts of predisposing factors other than mood states that can control perfectionism, and contribute to the development of psychological coaching methods to improve performance.

Second, mood states had no significant influence on choking in this study, which could be attributable to individual differences in personality traits [44]. High-pressure situations can lead some players to choke, and can stimulate clutch performance for others, leading to inconsistent findings [45–47]. Separately, Gill [48], Gould and Udry [49], Hanin [50,51], Kerr [52], Lazarus [53], and Males and Kerr [54] established that stress, confusion, and tension alone are not sufficient to explain the complicated relationship between mood states and athletes' motor performance ability. Overall, there are few empirical confirmations

of a relationship between mood states and choking, and it could be fruitful to study how individual personality traits affect mood state responses, such as tension and confusion.

Third, perfectionism had a positive influence on choking. Perfectionism is a personality trait characterized by setting excessively high standards for performance, and striving for superior performance to that of others to win a game in competition with others [55]. People with perfectionist tendencies have multidimensional personality traits characterized by overly critical evaluations of their own actions, and excessive sensitivity to mistakes [56–58], and perfectionism is visibly evident among athletes. Empirical findings from both domestic and overseas studies on perfectionism have showed that excessively high perfectionist tendencies can cause or aggravate psychopathology-related factors, including depression, tension [59–61], stress, fear, and anger [62–65]. Excessive perfectionism is also closely related to competitive state anxiety, burnout, and exercise stress [11,66,67].

University baseball players strive for perfection during games because these serve as the only window for them to appeal to professional teams, and we believe that obsession with perfection can lead to choking. It is also the case that in Korean society, baseball players are rated on the binary criterion of being either a success or a failure, and this pressure could lead to negative perfectionism. Baseball players who have spent many years pursuing their dream of becoming professional players are likely to have limited options to earn a living if they fail to advance to a professional team, and they can feel guilty about their families' sacrifices for their dream. These complicated mood states can cause athletes to redouble their efforts, and drive them toward an extreme level of perfectionism. Therefore, for players to perform without the pressure of perfectionism, family members and other people around young athletes lower their expectations for players' success.

Lastly, perfectionism had a mediating effect on the relationship between mood states and choking. It is well-known that negative mood states, such as tension or confusion, do not necessarily lead to choking, but some athletes experience more serious choking in performance, informally known as the yips. Perfectionism directly affected choking in this study, and had an indirect mediating effect on the impact of mood states on choking.

Previous researchers have established that perfectionism affects athletic performance, and that athletes feel more pressure in real games than they do in practice, triggering heightened emotions [40,68,69]. These results seem meaningful in that mood state and performance are not separable in some athletes: consistent, for instance, with So's [35] finding that emotional intelligence had a major influence on athletic performance.

The above findings suggest that counseling could protect athletes from manifesting extreme perfectionism, and, in turn, help make choking less likely under pressure, and that increasing the understanding and management of perfectionism, considering the distinct characteristics of baseball players, would be a valuable area for future research. In addition to the control and management of athletes' psychological conditions, reflection is warranted on whether coaches' teaching procedures and methods are appropriate, and whether the people around certain athletes, such as family members and relatives, have been careful with them in consideration of the players' perfectionism. Such reflective attitudes in the people around athletes can help relieve athletes' psychological burdens, and prevent manifestations of extreme perfectionism and choking, which can ultimately help athletes maintain high self-control of their mood states and perfectionism for better performance.

5. Conclusions and Suggestions

The purpose of the present study was to investigate relationships among mood states, perfectionism, and choking, and determine the mediating effect of perfectionism on the relationship between mood states and choking of Asian university baseball players in extremely stressful situations during a game. Based on our research results, we have the following conclusions.

First, mood states had a positive influence on perfectionism. Second, mood states had no significant influence on choking. Third, perfectionism had a positive influence on choking. Lastly, perfectionism had a (complete) mediating effect on the relationship

between mood states and choking. In the present study, we reach the conclusion that perfectionism is one of causes that leads to choking in extremely stressful situations. Mood states are simple moods felt under pressure, whereas perfectionism is an athlete's subjective perception of moods. Under usual situations, mood states do not affect choking or an athlete's performance. However, if perfectionism is involved in mood states in extremely stressful situations, perfectionism can affect choking directly, and acts as a mediator to allow mood states to affect choking indirectly. This result has never been reported by preceding studies. This evidence strongly suggests that with perfectionism controlled better, choking can be controlled better in competitive situations. Accordingly, perfectionism evaluation can be an important psychological scale of the choking-susceptible athlete to overcome choking.

Future research should be directed towards the identification of other psychological mediator variables that may evoke choking or performance decrements. Extending and classifying our knowledge of potential mediator variables, such as competitive anxiety or state anxiety, which increase the likelihood of choking, can allow us to improve interventions for performance decrement under pressure.

We think that follow-up observation and qualitative research designed to confirm the cause of the derived result will be significantly meaningful for helping athletes overcome choking (yips), or in preventing injury resulting from a sudden performance change.

Comparative studies that include various cultural and situational factors related to Asian university players should also be conducted. Additionally, follow-up studies targeting other nationalities, age-groups, athletic performance levels, and sexes should be conducted.

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The Influence of an Alpha Band Neurofeedback Training in Heart Rate Variability in Athletes

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Abstract: Neurofeedback training is a technique which has seen a widespread use in clinical applications, but has only given its first steps in the sport environment. Therefore, there is still little information about the effects that this technique might have on parameters, which are relevant for athletes' health and performance, such as heart rate variability, which has been linked to physiological recovery. In the sport domain, no studies have tried to understand the effects of neurofeedback training on heart rate variability, even though some studies have compared the effects of doing neurofeedback or heart rate biofeedback training on performance. The main goal of the present study was to understand if alpha-band neurofeedback training could lead to increases in heart rate variability. 30 male student-athletes, divided into two groups, (21.2 $\pm$ 2.62 year 2/week protocol and 22.6 $\pm$ 1.1 year 3/week protocol) participated in the study, of which three subjects were excluded. Both groups performed a pre-test, a trial session and 12 neurofeedback sessions, which consisted of 25 trials of 60 s of a neurofeedback task, with 5 s rest in-between trials. The total neurofeedback session time for each subject was 300 min in both groups. Throughout the experiment, electroencephalography and heart rate variability signals were recorded. Only the three sessions/week group revealed significant improvements in mean heart rate variability at the end of the 12 neurofeedback sessions ($p = 0.05$); however, significant interaction was not found when compared with both groups. It is possible to conclude that neurofeedback training of individual alpha band may induce changes in heart rate variability in physically active athletes.

Keywords: electroencephalography; neurofeedback; biofeedback training and RMSSD

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1. Introduction

Heart rate variability (HRV) is a measure of interest in the sports domain since it has been linked with autonomic nervous system (ANS) function and cardiovascular control. This system has been difficult to train/influence due to is nature in controlling the involuntary functions related to the organism [1]. It can be divided into two subsystems: sympathetic and parasympathetic. A greater activation of the former is observed in stressful situations, while the latter is more active in the recovery phases [2].

It has been reported that a decreased HRV is associated with worse clinical states [3,4], such as cardiovascular pathologies [5], panic disorder [6], depression [7] and anxiety [8] while an increased HRV has been positively associated with physiological health status [9], but only if a parasympathetic activity augmentation occurs and not a sympathetic activity augmentation [10,11]. Furthermore, relations have been established between HRV metrics and cognitive performance and emotional regulation [12,13], in which high values correspond to an increased ability of information processing and attentional focus maintenance,

suggested as important aspects to respond to changes in environment conditions [14,15]. Conversely, a lower HRV seems to be related to a greater sympathetic hyper-reactivity [16], which in turn is related to high stress [17], which has been appointed as a factor that can negatively impact sports performance [18].

From a technical perspective, HRV corresponds to the observed variation of the time interval between heart beats—RR intervals in the electrocardiogram signal [19], relevant in studying the cardiac behaviour in different contexts [20] and in gauging the state of the ANS [21]. The HRV temporal signal can be decomposed in a frequency power spectrum [22], with high frequency bands indicating prevalence of parasympathetic activity in the modulation of vegetative and cardiac activity. For short duration collections ($\leq$5 min), the variable showing more consistency analysis is the root mean square of successive difference of the R–R intervals (RMSSD), which has been shown to have higher reproducibility [23].

An increase in psychological stress levels causes a decrease in the intervals measured in the high frequency bands of the heart beat interval and an increase in the low-frequency ones [24]. Studies using electroencephalography (EEG) have shown that changes in cerebral electrical activity, most specifically a reduction in the power of alpha band frequencies, are related to higher stress [24–28]. We can therefore consider that higher HRV and alpha band values are related to lower psychological stress.

Considering that the capacity to process and select situational [29] and emotional regulation information [30] is a relevant aspect in the clinical and sports spheres, new training methods and cognitive assessment have emerged, as is the case with Neurofeedback training (NFT).

This cognitive biofeedback technique, in which an individual can learn how to modify its cerebral electrical activity, has been mostly used in therapeutic situations, with positive results in several psychiatric situations [31]. Recently, there has been an increase of its use in improving sports performance [32]. It has been proved that NFT promotes improvement of cognitive ability, reaction time and visuospatial abilities [33,34], giving individuals a base to create self-regulating strategies [35]. This, in addition to being essential for stabilization and increase in performance [36], can be improved through the use of NFT and consequently can lead to a higher performance [35,37–39]. These data are in conformity with previous studies that connect increased values of HRV with ANS activity and better performance [40], in addition to a reduction in stress both in athletes and in cardiovascular and chronical pain patients [36].

Bearing in mind the importance that physiological parameters such as HRV may have on athletic performance, it is important to know to what extent NFT can positively contribute to increase HRV and alpha band power. Bazanova et al. (2013) reported an increase in HRV following 10 NFT sessions aiming to increase the alpha power in a non-athlete male population [41]. Regarding HRV and NFT in sport, there are only four studies carried out, all of which compare HRV training by biofeedback with neurofeedback training [9,37–39], but they all assessed the effects of NFT on the athlete's HRV.

Therefore, and considering that it is still unknown how NFT influences HRV in athletes, the current study's aim was to determine if an α-NFT can increase HRV.

2. Materials and Methods

2.1. Subjects

Participants were randomized into two groups: (a) 3 sessions/week intervention group and (b) a 2 sessions/week intervention group [42]. A total of 30 male student-athletes aged between 18 and 34 years (mean (M) $\pm$ standard deviation (SD): 21.20 $\pm$ 2.62 for the two-session protocol vs. 22.60 $\pm$ 1.12 for the three-session protocol, p = 0.464) participated in the experiment. Of these 30 participants, 3 were excluded from the study due to poor-quality of the collected HRV data (1 from the 3 sessions/week group and 2 from the 2 sessions/week group). All student-athletes were provided with details about the study's requirements before providing written informed consent to participate. Participants

had to be involved in federated sports or practice regular physical activity (minimum of 30 min of at least moderate intensity 5 times a week) [43] for over 5 years [44]. The inclusion criteria were as follows: (1) all the participants had no history of psychiatric or neurological disorders; (2) no psychotropic medications or addiction drugs; (3) normal or corrected-to-normal vision; (4) minimum age of 18 years and maximum age of 35 years; and (5) to have been practicing vigorous exercise regularly at least 5 times a week regardless of skill level. All student-athletes were provided with details about the study's requirements before providing written informed consent to participate. This study was carried out in accordance with the recommendations of local ethics guidelines and approved by the Ethics Committee of the Faculty of Human Kinetics, University of Lisbon (24/2017, approval date 26 June 2017) and in accordance with the standards for ethics in sport and exercise science research [45]. All participants gave written informed consent in accordance with the Declaration of Helsinki [46]. All data collected have been stored in a database with password protection to which only researchers related to the NFT project have access. Anonymity was guaranteed.

2.2. Experimental Design

The 12 NFT sessions consisted of 25 trials of 60 s each with 5 s rest in-between, during which both EEG and HRV were recorded. The total NFT session time for each subject was 300 min in both intervention groups. Naturally, the participants who performed the most frequent protocol had more condensed NFT sessions than the subjects who per-formed the less frequent protocol.

Both the 2 sessions/week and the 3 sessions/week groups performed an instruction session and a pre-test before the 12 NFT sessions. At the end of completing all NFT sessions, a post-test was performed. The instruction session consisted in 5-min NFT practice trial, for participants to understand the training feedback, with instructions being given to clarify the purpose of these procedures in the context of the study. Both pre and post-tests were carried out on the same day of the first and last training sessions, respectively. In the beginning of each session, prior to the NFT, there was also a resting baseline recording which consisted of four epochs/periods of 30 s: two with the eyes open (EO) and two with the eyes closed (EC).

The participants were asked to be as relaxed as possible and to concentrate on a specific sport task.

2.3. Electroencephalography (EEG)

2.3.1. Data Acquisition

During the experiment, the participants sat in a room with a controlled environment—silent room with no light. The EEG signals were recorded according to the international 10–20 system (Fp1, Fp2, F3, F4, F7, F8, C3, C4, T3, T4, P3, P4, T5, T6, O1, O2, Fz, Cz, and Pz), with a sampling frequency of 256 Hz. The Cz channel was chosen for feedback since this location is at the primary motor cortex and has been associated with sensory information processing over the sensorimotor area. Furthermore, it provides a measurement of the activity in both hemispheres and in the frontal lobe [47,48].

The ground was located at the forehead and the reference was the average of left and right mastoids. The signals were amplified by a 24-channel system (Vertex 823 from Meditron Electomedicina Ltd.a, São Paulo, Brazil) and were recorded by Somnium software platform (Cognitron, São Paulo, Brazil). The signals were filtered with an analog band-pass filter from 0.1 to 70 Hz in the amplifier and a digital band-pass filter from 4 to 30 Hz. Circuit impedance was kept below 10 kΩ for all electrodes before the sessions. Subjects were asked to sit comfortably and then to remain as still as possible and to avoid excessive blinking as well as abrupt movements.

2.3.2. Individual Alpha Band (IAB)

Since a large interindividual difference in the alpha band has been reported, an individual alpha band (IAB) is often used instead of a standard fixed band based on a normative population [49].

EEG recordings of EO and EC periods during the resting baseline provide data for the calculation of alpha desynchronization and synchronization, respectively, enabling to determine frequency bands for each participant through amplitude band crossings [49]. The EEG signal for the channel Cz was notch-filtered at 50 Hz and lowpass-filtered at 30 Hz. The Welch's method was used to compute the power spectrum density for EO and EC, using an overlap of 10% and segments of 5s. The crossings between the two power spectra provide the transition frequencies to neighbouring bands: the lower frequency boundary (LB) of IAB and the upper frequency boundary (UB) of IAB. Thus, they define the IAB, which lays between the two crossings, as illustrated in [50]. The IAB information and their statistical comparisons between two NFT groups are summarized in Table 1.

Table 1. Descriptive differences between groups in relative IAB amplitude and HRV means.

	M ± SEM		
	Two-Session Protocol (n = 13)	**Three-Session Protocol (n = 14)**	***p***
IAB S1	1.56 ± 0.08	1.46 ± 0.07	0.366 [a]
IAB S12	1.58 ± 0.11	1.69 ± 0.09	0.171 [a]
HRV (RMSSD) S1	59.05 ± 5.50	49.68 ± 6.97	0.306 [a]
HRV S12 (RMSSD)	65.19 ± 3.00	65.59 ± 7.09	0.960 [a]

M, mean; SD, standard deviation; IAB, individual alpha band; HRV, heart rate variability; RMSSD, root mean square of successive differences between normal heartbeats; S, session.[a] Differences between groups tested with Student's *t*-test.

2.4. NFT Intervention Procotol

Feedback is a determinant step for the protocol's success. Neural activity must be fed back by some parameter(s) and presented to the participant in a simple and direct representation of their value. In this study, the feedback parameter was the relative IAB amplitude in channel Cz, which uses the amplitude from 4 to 30 Hz as a normalization factor for IAB. This is calculated as in Equation (1), where the numerator indicates the averaged amplitude in IAB, denominator indicates the averaged amplitude in 4–30 Hz, the LB is the lower frequency boundary (LB) of IAB, UB is the upper frequency boundary (UB) of IAB, and X(k) is the frequency amplitude spectrum calculated by fast Fourier transformation (FFT) with a sliding window of 2 sec that shifted every 125 ms. The frequency resolution was 0.5 Hz. Using the amplitude spectrum instead of the power spectrum prevents excessive skewing, which results from squaring the amplitude, and thus increases statistical validity [51].

$$\text{Relative IAB amplitude} = \frac{\frac{\sum_{k=LB}^{UB} X(k)}{UB-LB}}{\frac{\sum_{k=4}^{30} X(k)}{30-4}} \quad (1)$$

The EEG training plugin included in the Somnium software was used to provide the visual feedback and is further detailed in [50]. The visual feedback display contains two objects: the first one in the centre and a second one in the lower left corner. These two objects change their shape and position, respectively, if the feedback parameter exceeds a certain predefined threshold (goal 1) and, in that case, if the participant is able to achieve goal 1 during a predefined amount of time (goal 2).

The central object is a small white prism with a rhombus base (four-sided) that changes. If goal 1 is being achieved, the number of sides of the base increases, progressively shaping and smoothing the white prism into a bigger purple sphere. If goal 1 stops being achieved,

the number of sides progressively decreases back to the initial rhombus shape, with its colour fading back to white and its size diminishing.

The second object is a cube whose position on screen is related to the period during which goal 1 kept being achieved continuously. If it happens for more than a predefined period of time (2 s), goal 2 is accomplished, and the cube moves upwards until goal 1 stops being achieved. If that happens, it will start moving downwards back to the initial position unless goal 2 is achieved again. Therefore, the participant's task is to move the cube upwards as much as possible [50].

The feedback threshold was set to 1.0 in the first session (i.e., the quotient between the mean IAB amplitude and the EEG total average amplitude 3–40 Hz had to be larger than 1, as shown in Equation (1)) Afterwards, it was adjusted according to the percentage of time during which the feedback parameter was above the threshold in each session. If this percentage exceeded 60%, the threshold would be increased by 0.1 in the next session. In contrast, if the percentage was below 20%, the threshold would be decreased by 0.1 in the next session [52].

Although inhibiting mental self-talk seems to be one of the best strategies to achieve self-regulation of EEG activity during NFT [49,53–56], participants were instructed only to concentrate on their sport activity as much as possible. If the feedback provided on screen was positive and the goals were being achieved, that would mean their strategy was working. If not, they were encouraged to find new strategies to achieve the goals.

2.5. Heart Rate Variability (HRV)

2.5.1. Data Acquisition

For HRV analysis the RR interval data were gathered during the training session, in accordance with the methodological considerations proposed by the European Society of Cardiology (1996) and by Billman and associates (2015) [57,58]. The cardiac cycle duration and respective RR intervals were measured using a Polar H7 (Kempele Finland) heart rate monitor strapped around the participant's chest. The RR interval data were paired with the Elite HRV collection application, and processed and analysed using Kubios software (Kuopio, Finland).

2.5.2. Root Mean Square of Successive Differences (RMSSD)

The HRV was analysed using a time-domain measure, RMSSD, which corresponds to the root mean square of the successive differences between adjacent RR intervals (RRI). Data collection started after a 30 s stabilization period, following which RR intervals were monitored throughout the duration of the task. RR interval data was recorded at a rate of 250 Hz following the equation:

$$\mathrm{RMSSD} = \sqrt{\frac{\sum_{i}^{N}(\mathrm{RR_{i+1}} - \mathrm{RR_i})^2}{N-1}} \quad (2)$$

where $(\mathrm{RR_{i+1}} - \mathrm{RR_i})^2$ corresponds to the square of the difference between RR interval time-length, N corresponds to the total number of intervals. RMSSD was chosen as the HRV variable of interest since it seems to be more related to vagal activity [57] and has shown greater reliability than other spectral variables indicators [23].

2.6. Statistical Analysis

The comparison of session means related to the relative amplitude of IAB and HRV were performed using Student's t-test for independent samples and Mann-Whitney U when normality was not verified. Generalized estimating equations, followed by Bonferroni post hoc test, were used to estimate between-group and within-group effects on IAB and HRV. Data were analysed using SPSS software for Windows version 25.0 (SPSS Inc., Chicago, IL, USA). Statistical significance was established as $p < 0.05$ in all tests. Computed by G*Power software (version 3.1.9.4) for a 0.05 significance level and a 0.95 power before experiment.

3. Results

Differences between relative IAB amplitude and HRV means during NFT training between both protocols are presented in Table 1.

Table 2 presents the results concerning IAB and HRV at baseline and after 12 sessions, as well as the effect of interaction using per-protocol analyses for each group (time—session 1 and session 12—vs. group).

Table 2. Individual alpha band and heart rate variability at session 1 and session 12: within and between protocol groups.

	Two-Sessions Protocol (2S)		Three-Sessions Protocol (3S)		2S*3S β(95%CI)
Variables	**Session 1**	**Session 12**	**Session 1**	**Session 12**	
IAB (n = 14)	1.56 ± 0.08	1.58 ± 0.11	1.46 ± 0.07	1.69 ± 0.09 [b]	0.211 [a] (0.036; 0.386)
HRV (n = 13)	59.05 ± 5.50	65.19 ± 3.00	49.68 ± 6.97	65.59 ± 7.09 [b]	9.768 (−7.67; 27.21)

IAB, Individual alpha band; HRV, heart rate variability. Betas are presented as unstandardized coefficients between the interaction time*group with the respective 95% confidence intervals. [a] Between-group changes significant at $p < 0.05$ [b] Within-group changes significant at $p < 0.05$.

When considering the interaction time with the group, only the three-sessions protocol experienced changes in the IAB (β, 0.211; $p = 0.018$). Moreover, it was found significance between session 1 and session 12 in IAB (β, 0.237 $p < 0.001$) and in HRV (β, 15.909 $p = 0.025$).

4. Discussion

The aim of the study was to verify whether the NFT had direct implications for the increase in HRV. IAB was used to perform the NFT and two different groups to help clarify the extent to which this biofeedback training could impact on HRV.

Higher HRV values have been correlated with a greater information processing capacity and attention focus maintenance, suggested as important aspects in order to respond to changes in environment conditions [15]. According to Lehrer and colleagues (2000), HRV alterations due to biofeedback training in respiratory control are also associated with a higher capacity for regulating heart rate, which the authors suggested as being related to a more efficient action of baroreflexes [14]. Other interventions that led to an increase in HRV seem to be related to changes in important aspects of sports performance, such as a better technique and lower anxiety index [38].

According to data presented in Table 2, when the total training period (12 weeks) is considered, we verify that only the group that performed the most frequent training per week improved both relative IAB amplitude and HRV (RMSSD) means significantly. If an NFT is applied with a weekly frequency of three sessions, the results can clearly be achieved after 12 sessions, but the same does not happen with a lower weekly NFT frequency protocol in IAB. This lower frequency intervention will probably need more total sessions so that the effects can be observed. Even though HRV demonstrates significant changes, it is imperative to notice that had nothing to do with the group interaction. The group that performed the 3 weekly sessions had on average, a lower baseline value than the group that performed the 2 weekly sessions. However, Table 1 proves that the baseline values between groups are not significantly different, which further reinforces the effectiveness of a training in the IAB with a weekly load of three sessions.

As already mentioned, in addition to the fact that there are few studies in the sport/exercise research field that combine NFT and HRV, they only compare the effects of each training protocol without analysing how NFT can influence HRV [9,37–39]. Despite this, Rijken (2016) was careful to mention that although their study was not performed to understand the influence of NFT on HRV, he observed what seemed to be an association between the two variables [39]. These data are supported by a previous study that demonstrated the influence of an alpha band training (NFT) on HRV [59]. Recently, a case study was carried out on a patient with stroke and it was found that NFT had a positive effect on

increasing HRV [60]. Although this is only one case and belongs to a very different from that observed in this study, the results are in agreement with our findings.

The main strength of the study and what makes it so important is that it is the first study, of our knowledge, that tries to understand the influence of an α-NFT in the increase of HRV in athletes, demonstrating that performing thee neurofeedback sessions per week can lead to improvements in HRV. The training individualization was also considered (IAB was used instead of the fixed alpha band) [49].

There were some limitations that should be considered. First, the mental strategies were not recorded. Future work should include a questionnaire or scale to better understand what strategies athletes/individuals are using during NFT and which mental strategies are helpful to enhance NFT learning of training frequency band activity [38]. The present study should therefore be considered exploratory. Additionally, no cognitive laboratory tests or stress and anxiety scales were performed to notice physiological and psychological behavioural changes, thus it is imperative to not generalize the results. Finally, it would be important to include a sham group.

5. Conclusions

Ultimately, the 3 sessions/week group showed effective increments in relative IAB amplitude and HRV (RMSSD) mean values in student athletes. However, no interaction between groups and HRV time were found. suggesting that NFT can indeed be an effective tool to consider in the sports domain, in order to induce changes in HRV and cognitive parameters, but has nothing to do with the weekly training frequency. Future research should replicate the three sessions/week protocol based on a pre-test and post-test associated to anxiety and stress scales and in agreement with specific sport performance to better understand how the increased alpha and consequently higher HRV contributes to a better sporting performance. Additionally, stronger conclusions could be drawn in future studies with sham control conditions.

Author Contributions: C.D., A.A. conceived and designed the study and performed the analysis and interpretation of the data. C.M.d.S., I.E., P.P. and A.C.R. drafted, revised, and approved the final version. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: All students were informed about the possible risks of the investigation before providing written informed consent to participate. This study was carried out in accordance with the recommendations of local ethics guidelines and approved by the Ethics Committee of the Faculty of Human Kinetics, University of Lisbon (24/2017, approval date 26 June 2017) and in accordance with the standards for ethics in sport and exercise science research [39].

Informed Consent Statement: Informed consent was obtained from all individual participants included in the study. All data collected has been stored in an encrypted database where only researchers related to the NFT project have access. Anonymity was guaranteed.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Article

The Role of Gender in Association between Emotional Intelligence and Self-Control among University Student-Athletes

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Abstract: The purpose of this study was to reveal the peculiarities of undergraduate studies university student-athletes' emotional intelligence and self-control indicators, and the role of gender as a predictor in the association between emotional intelligence and self-control. The study included students regularly involved in training at least three times a week. The sample consisted of 1395 student athletes from Lithuanian universities, among them 59.2% female and 40.8% male. For measurement, the SSRI inventory and a self-control scale were used. All values of emotional intelligence indicators were significantly higher for males than females. Estimates of the components of the self-control construct varied. The score for the healthy habits component was significantly higher for women than for men, the self-discipline component did not differ significantly, and the other three components were higher for males. Estimates of the components of the self-control construct varied. Models for predicting the values of self-control components were proposed. Only one component of the emotional intelligence construct, optimism, was repeated in all forecasting models, as well as gender. Other components of emotional intelligence vary in models.

Keywords: emotional intelligence; self-control; gender; student-athletes

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1. Introduction

The expression of emotional intelligence and self-control in various human activities, including sports, has been extensively studied in recent decades. Research on emotional intelligence and self-control in students, young people, and top athletes are quite extensive [1–8]. However, researchers pay less attention to those, who train regularly three-to-four times a week only for the need for physical activity, but not for the pursuit of sporting results [9,10].

Emotional intelligence. There is no consensus among researchers on a unified concept of emotional intelligence. Three emotional intelligence models are used most often in emotional intelligence studies: ability-based models [11,12], traits-based emotional intelligence models [13], and mixed models [14]. The concept of emotional intelligence by Mayer et al. is submitted as follows, "the ability to perceive accurately, appraise, and express emotion; the ability to access and/or generate feelings when they facilitate thought; the ability to understand emotion and emotional knowledge; and the ability to regulate emotions to promote emotional and intellectual growth" [15] (p. 511). They proposed a the four-branch model "(a) accurately perceiving emotion, (b) using emotions to facilitate thought, (c) understanding emotion, and (d) managing emotion" [15] (p. 513).

The theoretical justification of trait emotional intelligence is presented in the study [16]. The trait emotional intelligence concept model consists of five components: "adaptability, assertiveness, emotional appraisal (self and others), emotional expression, and emotion management (others)" [16] (p. 428). The trait emotional intelligence model reflects behavioral attitudes and self-perceptions related to the ability to recognize, assimilate, and use information about emotions. The trait emotional intelligence model is considered to

be useful in research related to the social context [17]. The trait emotional intelligence questionnaire is mentioned as one of the best instruments for trait emotional intelligence measurements [17]. In terms of measurement, according to the review study, the traits emotional intelligence questionnaire can be considered a "gold standard" for a full-scale estimation of trait emotional intelligence [18]. The estimates of traits emotional intelligence could become important indicators of personal development in the educational and social fields, as well as in professional development [8]. Although, there are opinions [19] that the trait model better reflects emotional intelligence, [12] substantiate the completeness and suitability of the competency abilities model for emotional intelligence studies.

There are opinions that the trait model better reflects emotional intelligence than the abilities model [19]. However, the proponents of the abilities model substantiate the completeness and suitability of the competency abilities model for emotional intelligence studies [12].

Their improved emotional intelligence construct includes four emotion management abilities perceiving emotions, facilitating thought using emotion, using emotion, understanding emotions, and managing emotions [12]. Emotional intelligence reveals the ability to adapt, select, and change situations by recognizing and managing emotions and more successful athletic performance athletes engaged in a variety of sports [20,21].

Emotional intelligence is associated with satisfaction in achievement in sports [22]. The level of emotional intelligence has a potentially positive effect on the achievements of athletes and the quality of coaching activities, according to the findings in research [23]. The prognostic importance of emotional intelligence is especially relevant in self-control in competitive sports [24]. Emotional intelligence is also associated with self-control skills and the motivation of athletes themselves to play sports and achieve good results [25].

Although, there are studies in various fields where no significant differences were found in the values of emotional intelligence indicators in terms of gender [26,27]. The results of studies showed that training can significantly improve students' emotional intelligence [28–30].

Unfortunately, the trait emotional intelligence questionnaire has not been translated, tested, and validated with Lithuanian-speaking subjects. Therefore, the Schutte self-report inventory (SSRI), based on the original Salovey and Mayer model [21], was used for this study because it has been tested and validated with a sample of Lithuanian-speaking participants [22].

Self-control. Tangney, Baumeister, and Boone define man's ability to control himself as "arguably one of the most powerful and beneficial adaptations of the human psyche" [31] (p. 272). People are happier and healthier when they better adapt to the environment. One of the most important features of adapting to the environment is the trait of self-control [31]. Some people, thanks to self-control, can manage much better than others in their paths in life. They can better deliver on promises and achieve better results at work. Better self-control skills could likely be associated with higher achievement in certain areas of activity [31].

The concept of self-control [31] is the ability to ignore or control one's internal reactions, to change unwanted behaviors or, in other words, the ability to control oneself [31]. Thus, in this respect, self-control is likely to have a positive effect on various human achievements in life.

Terms that are often used in the literature as alternatives to the term self-control are self-regulation, self-discipline, and willpower [32]. However, they are not used identically. Baumeister et al. [33] argue that self-control is a specific form of self-regulation where the individual consciously and consciously seeks to control himself, and self-regulation is a more general concept that comprises automatic and involuntary regulatory processes.

Studies have shown that a feature of self-control can vary from person to person, and that may interact with environmental variables and change significantly as internal resources change [34,35]. Research has revealed the importance of self-control as a significant

psychological parameter in solving problems such as unethical or immoral behavior [36] and risk-taking [37]. Decreased ego can lead to risky behaviors [37].

According to the proponents of the willpower concept, willpower is certain energy whose resource is specific to individuals [32,38]. Decreases in willpower energy can disrupt self-control and worsen an individual's attention or concentration. There is no consensus on the use of willpower energy resources. There are two approaches, one is that in the process of self-control energy resources are reduced and the second is that willpower energy resources are unlimited. Researchers have revealed that individuals can be divided into two main groups: some believe that willpower energy resources are unlimited, and others that willpower energy resources decrease during self-control processes and this may be related to individual performance [39]. The results of a study showed that those who believe in the inexhaustibility of willpower energy resources achieve better performance [39]. Those who believed that in the process of self-control willpower energy resources were depleted, performed worse than the first group of subjects. The differences in the research performance of the two groups can be explained by different approaches to resources from a psychological perspective.

An ability of self-control is significant in a variety of sports and for exercise behaviors as well as athletic outcomes [40]. A review analytical study indicates that individuals with a high level of self-control manage their emotions better than individuals with a low level of self-control, achieving higher results in exercise [41]. In addition, it was revealed that various types of exercise potentially affect an individual's ability to self-control [41].

It is considered that very good self-control skills are likely to be important for individuals' physical activity [41]. The results of the study revealed that to young athletes, there are links between self-control achievement in sports competitions, motivation, and the weakening of self-control [42]. Harmful prior efforts to strengthen self-control have been identified as this may reduce athletic performance [43].

Different studies reveal contradictory self-control results. Females have been seen above their self-control skills than their male counterparts [44]. There are also conflicting results that male young people showed better self-control skills than females [45]. Additionally, a study in which the 16–19-year-olds displayed no significant differences in self-control indicators in terms of gender [46]. The self-control level of preschool student females was higher than pre-school student males [47]. Other researchers have noted the worse self-control level in males compared to females [48]. For top-level performance athletes, the highest level of self-control is very important and it is not clear why athletes of both genders sometimes make mistakes under pressure due to the diverse factors on the lack of self-control [49]. Scientists are increasingly expressing the view that the fluctuations of the performances of athletes are potentially determined by the decrease in self-control [50]. The contradictory results in studies may be obtained due to differences in the sample properties, environment, and research instruments.

The above overview of emotional intelligence and achievement in sport, and that athletes' performance may be affected by self-control abilities, and thus interfaces of emotional intelligence with self-control, suggests possible reliable correlations between emotional intelligence and self-control in young athletes, and more specifically for student-athletes. Therefore, the purpose of this study was to reveal the peculiarities of undergraduate studies university student-athletes' emotional intelligence and self-control indicators, and the role of gender as a predictor in the association between emotional intelligence and self-control.

The hypothesis is as follows: there are significant differences in emotional intelligence and self-control among university student-athletes in terms of gender, and gender is a significant predictor in the association between emotional intelligence and self-control.

2. Materials and Methods

2.1. Participants

The study was conducted at 7 of 13 state universities with over 5000 student-athletes.

The study included students regularly involved in training at least three times a week. In this study, they are called student-athletes. They are considered to be a participant in organized competitive sports, supported by the university in which the student is enrolled, but does not represent a university or national team. Participants were selected by purposive sampling. The sample consisted of 1395 undergraduate studies university full-time student-athletes from Lithuanian universities, among them 826 females and 569 males. The age of the subjects was 23.66 ± 2.23 years. Everyone participated in the study voluntarily, with no financial incentive, and they were informed of their right to terminate their participation in this investigation at any time. A purposive sampling method was used to select subjects. The research was conducted following the principles of reliability, honesty, respect, and accountability. The Ethics Committee of Social Sciences Research of the Lithuanian Sports University has issued a permit to conduct this research as meeting the ethical and legal requirements in Lithuania, where the research was conducted. The researchers provided participants with information about the study, its goals and objectives, and the progress of the study. Subjects were informed that their personal data would be processed and stored following the requirements of the Personal Data Protection Code. Subjects were provided with questionnaires, which they completed during the sessions and the duration of the process was not limited. Subjects were able to express their agreement or refusal to participate in the study by completing the questionnaire and marking one of the possible answers at the beginning of the questionnaire in the sociodemographic part of the questionnaire: "I agree to participate" or "I disagree to participate".

2.2. Instruments

The questionnaire for this investigation was based on the inventory and scale from scientific literature [31,51]. It included information on the age, gender, number of training sessions per week, emotional intelligence, and self-control indicators. The study used the two following inventory and scales: Schutte Self-Report Inventory (SSRI) [51] and the Tangney Short Self-Control Scale [31].

It was previously mentioned that the trait model better reflects emotional intelligence [19]. Unfortunately, the trait emotional intelligence questionnaire has not been translated, tested, and validated with Lithuanian-speaking subjects. Therefore, the Schutte Self-Report Inventory (SSRI), based on the original Salovey and Mayer model [52], was used for this study because it has been tested and validated with a sample of Lithuanian-speaking participants, and a reliability value of 0.84 was obtained for the entire SSRI [53]. The Schutte Self-Report Inventory is based on the four-branch emotional intelligence ability model [52]. The model contains four components of the emotional intelligence construct, namely optimism, social skills, appraisal, and utilization [12]. The Schutte Self-Report Inventory is most commonly used to examine emotional intelligence in terms of abilities, as noted in [17]. All of the 33 items of The Schutte Self-Report Inventory were evaluated on a Likert five-point scale, respectively: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree.

The internal consistency of the SSRI for this study was verified by calculating Cronbach's alpha coefficients of subscales (Table 1) and for the whole SSRI—0.789.

The self-control scale was used in this study to evaluate the self-control level of subjects [31]. The self-control scale contains five components, namely self-discipline, non-impulsive action, healthy habits, work ethic, and reliability [31]. The self-control scale consists of 36 items that the participants were evaluated on a Likert five-point scale, namely 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

Table 1. Cronbach alpha, means, and standard deviation of the variables of the total sample and by gender, and Student *t*-test.

Component of Construct	Cronbach Alpha	Total Sample n = 1395		Female (n = 826)		Male (n = 569)		t
		M	SD	M	SD	M	SD	
Schutte Self-Report Inventory								
Optimism	0.903	4.08	0.828	3.94	0.811	4.27	0.815	−7.40 ***
Social Skills	0.867	4.15	0.778	3.92	0.751	4.47	0.694	−13.97 ***
Appraisal	0.638	4.18	0.711	3.99	0.727	4.46	0.581	−13.00 ***
Utilization	0.813	3.97	0.694	3.88	0.668	4.09	0.710	−5.83 ***
Self-Control Scale								
Self-Discipline	0.721	2.98	0.421	2.97	0.434	3.00	0.402	−0.923
Non-Impulsive Action	0.664	2.96	0.446	2.94	0.449	3.07	0.538	−4.67 ***
Healthy Habits	0.784	3.03	0.663	3.08	0.663	2.97	0.657	2.94 **
Work Ethic	0.663	3.00	0.610	2.98	0.608	3.12	0.632	−4.37 ***
Reliability	0.751	3.07	0.648	2.87	0.482	3.26	0.663	−2.17 *

Notes. * $p < 0.05$ (two-tailed); ** $p < 0.01$ (two-tailed); *** $p < 0.001$ (two-tailed).

The self-control scale was translated into Lithuanian and tested with Lithuanian-speaking subjects [54]. The internal consistency of the Self-Report Inventory for this study was verified by calculating Cronbach's alpha coefficients of subscales (Table 1) and for the whole scale—0.786.

The questionnaire was provided to the subjects in printed form and administered by the investigators. Assistance in distributing and compiling the questionnaires was provided by the coaches.

2.3. Statistical Analysis

Data were analyzed using descriptive statistics and IBM Statistics for Windows 22.0. The coefficients of asymmetry and excess were calculated to check the initial data distribution. As the calculated values of the coefficients ranged from −2 to 2, it can be assumed that the raw data distribution is slightly away from the nominal distribution [55]. The Student *t*-test was used to assess the difference between the mean estimates of the components of emotional intelligence and self-control constructs. Pearson correlations (two-sided) were calculated as continuous variables. Since no one correlation coefficient overshoots 0.70, the multicollinearity assumption was satisfied. A stepwise multiple regression analysis was carried out, to respond to whether and to what extent emotional intelligence indicators and gender the gender of the subjects allows you to predict self-control indicators' values.

3. Results

The Cronbach alpha coefficients, means, standard deviation of the variables of emotional intelligence and self-control scales from this study results are presented in Table 1.

This study revealed that values of all components of the construct of emotional intelligence in terms of gender differ statistically significantly ($p < 0.05$). In addition, males' self-ratings are higher than females' in all components of the emotional intelligence construct.

Females rated themselves better than males only on the healthy habits component of the self-control construct. Estimates of other components are higher in males than in the female. In addition, they differ significantly ($p < 0.05$). Only the estimates of the self-discipline component of the self-control construct for females and males did no differed significantly ($p > 0.05$).

The Pearson correlation coefficients between estimates of emotional intelligence components, self-control components, and gender are shown in Table 2.

Table 2. Pearson correlations coefficients amongst emotional intelligence, self-control components, and gender.

Variable	1	2	3	4	5	6	7	8	9	10
Self-Discipline	1	0.145 **	0.125 **	−0.110 **	−0.303 **	0.143 **	0.054 *	0.067 *	0.091 **	0.125 **
Non-Impulsive Action	0.145 **	1	−0.108 **	0.064 *	−0.203 **	0.219 **	0.152 **	0.072 *	0.083 **	0.124 **
Healthy Habits	0.125 **	−0.108 **	1	−0.122 **	0.098 **	0.131 **	0.115 **	0.108 **	0.081 *	0.079 **
Work Ethics	−0.110 **	0.064 *	−0.122 **	1	−0.111 **	0.122 **	0.076 *	0.086 *	0.122 **	0.116 **
Reliability	−0.303 **	−0.203 **	0.098 **	−0.111 **	1	−0.130 **	−0.089 **	−0.129 **	0.108 **	0.058 *
Optimism	0.143 **	0.219 **	0.131 **	0.122 **	−0.130 **	1	0.226 **	0.226 **	0.170 **	0.194 **
Social Skills	0.054 *	0.152 **	0.115 **	0.076 *	−0.089 **	0.226 **	1	0.357 **	0.308 **	0.351 **
Appraisal	0.067 *	0.072 *	0.108 **	0.086 *	0.129 **	0.226 **	0.357 **	1	0.252 **	0.329 **
Utilization	0.091 **	0.083 **	0.081 *	0.122 **	0.108 **	0.170 **	0.308 **	0.252 **	1	0.154 **
Gender	0.125 **	0.124 **	0.079 **	0.116 **	−0.058 *	0.194 **	0.351 **	0.329 **	0.154 **	1

Notes. * $p < 0.05$ (two-tailed); ** $p < 0.01$ (two-tailed). 1—self-discipline, 2—non-impulsive action, 3—healthy habits, 4—work ethics, 5—reliability, 6—optimism, 7—social skills, 8—appraisal, 9—utilization, 10—gender.

All Pearson correlation coefficients are statistically significant. These components of the emotional intelligence construct are most related to the components of the self-control construct. Optimism is most strongly correlated (r = 0.219) with non-impulsive action, social skills with non-impulsive action (r = 0.152), appraisal with reliability (r = 0.129), utilization with work ethics (r = 0.108). The gender correlates strongly with social skills (r = 0.351) and weakest with healthy habits (r = 0.079).

A stepwise multiple regression analysis was carried out, to respond to whether and to what extent emotional intelligence indicators and gender allows you to predict self-control indicators' values. The results of linear stepwise regression analysis are shown in Table 3.

Table 3. The results of linear stepwise regression analysis of study variables.

Model	R	R^2	R^2 Adjusted	R^2 Change	F (df)	β	β Standardized	t
Dependent variables: components of the self-control scale								
Independent variables: components of the emotional intelligence inventory and gender								
Dependent variable: self-discipline								
Model 1								
Constant						2.824		12.89 ***
Optimism	0.156	0.024	0.023	0.018	17.685 (1393) **	0.328	0.287	5.341 ***
Utilization						0.321	0.305	1.157 *
Gender						0.218	0.197	2.458 **
Dependent variable: non-impulsive action								
Model 2								
Constant						3.237		15.55 ***
Optimism	0.364	0.167	0.143	0.101	9.963 (1393) **	−0.238	−0.220	−3.461 ***
Social Skills						0.438	0.418	2.562 **
Gender						0.192	0.188	2.511 **
Dependent variable: healthy habits								
Model 3								
Constant						2.916		12.833 ***
Optimism	0.363	0.132	0.11	0.058	10.586 (1392) **	0.528	0.363	3.096 **
Social Skills						0.427	0.401	3.051 **
Appraisal						−0.125	−0.108	2.842 **
Gender						0.452	0.415	2.088 *

Table 3. *Cont.*

Model	R	R^2	R^2 Adjusted	R^2 Change	F (df)	β	β Standardized	t
Dependent variable: work ethics								
Model 4								
Constant						4.543		10.95 ***
Utilization	0.388	0.151	0.15	0.15	18.3 (1392) ***	−0.544	−0.478	4.317 ***
Optimism						0.238	0.226	3.015 **
Gender						0.387	365	1.251 *
Dependent variable: reliability								
Model 5								
Constant						2.817		13.008 ***
Optimism	0.428	0.178	0.177	0.028	8.983 (64) ***	0.518	0.347	4.056 ***
Appraisal						0.487	0.388	2.312 *
Utilization						0.258	0.225	2.587 **
Gender						0.359	0.312	2.098 *

Notes. * $p < 0.05$ (two-tailed); ** $p < 0.01$ (two-tailed); *** $p < 0.001$ (two-tailed).

Only two study variables, the gender, and emotional intelligence component optimism, and the constant, as shown by the results of the stepwise regression analysis, are included in all five prediction models. Mostly, three components of emotional intelligence are included in the self-control components as healthy habits and reliability prediction models.

4. Discussions

This study was designed to test the hypothesis that there are significant gender differences in emotional intelligence and self-control among university student-athletes, and gender is a significant factor in the links between emotional intelligence and self-control.

Based on the results of the statistical analysis of the data, it can be stated that many of the assumptions raised in the hypothesis were confirmed. Estimates of the components of emotional intelligence and self-control constructs differ significantly, except for one component of self-discipline.

The university student-athlete male self-rated higher than the student-athlete female in components of emotional intelligence that optimism, social skills, appraisal, and utilization, also in components of self-control construct, non-impulsive action, work ethics, and reliability. Females, meanwhile, rated themselves significantly higher on only one component of healthy habits. Self-discipline is likely a more common characteristic of student-athletes and the differences between women and men estimates are very small ($p > 0.05$).

Our results were different in some aspects from the results of other studies. The results of our research are not contrary to the results of some other investigators, they have identified significant differences in the three emotional intelligence construct components of gender [56]. So, according to the results, although some differences in the components of emotional intelligence constructs were found in males and females, the overall assessment did not differ significantly in terms of gender [57].

There are several studies whose results did not show significant differences in emotional intelligence either as a whole or in the components of the construct in terms of gender [26,27,58]. The findings of this study confirm the results of other studies that significant differences in the components of emotional intelligence between females and males are possible [59–61].

Assessing the components of the self-control construct values, identified in our study, from a gender perspective, the male self-assessment scores were higher ($p < 0.05$) than the female components for non-impulsive action, work ethics, and reliability. Meanwhile, females rated themselves higher than males ($p < 0.05$) in only the component healthy habits. No difference ($p > 0.05$) was found for the component self-discipline between estimates for

females and males. In our previous research, no significant gender differences of athletic and non-athletic postgraduate students were found, but males rated self-discipline and reliability higher and females rated non-impulsive actions higher [62].

The results obtained in our study are partially inconsistent with those obtained by other researchers. The university student female in some aspects has better self-control than male. However, neither gender nor self-control traits have not significantly affected the choice of exercise [62]. Highly high self-control levels can help young people stay in the chosen sport [63]. Higher, though statistically insignificant, self-control levels for females than males were determined by a representative sample of persons aged from 12 to 34 years [64].

As revealed, self-control gender differences may occur at short intervals, while at long-term intervals, these differences are insignificant because the traits of the self-control of males and females are developed by similar models. Similar relationships between self-control and social factors are characteristic of both genders also [65,66].

Estimates of male self-control components higher than a female can be interpreted based on the expected value of control theory [67]. Males likely expect better achievements and better rewards for these achievements.

At the time of sporting activities to achieve better results, a higher level of self-control is likely required. In this case, the self-control efforts, in other words, the depleted willpower resources, can reduce the effectiveness of another area of activity, such as the academic activity performance [41]. This reveals that persons with higher self-control levels are happier and their relationships are better [68].

Researchers pointed out that self-control skills are vital for a person, high self-control skills enable an individual to achieve more in professional or academic activities and to feel better with their well-being [68]. However, wasting a lot of effort on self-control can start to make you feel tired or weaken your motivation for the activity. These thoughts evoke the opinions of researchers who believe that the resources of self-control (willpower) are limited and dwindling [39].

Our study revealed significant Pearson correlations between all components of emotional intelligence construct components and self-control constructs components and gender. Thus, the gender factor in this study plays an important role in describing individuals' emotional intelligence, self-control, and interrelationships.

All components of the emotional intelligence construct are positively related to the elements of the self-control construct self-discipline, non-impulsive action, healthy habits, and work ethics. Except for the component reliability, which was negatively associated with optimism, social skills, and appraisal, but positively with utilization. In this study, we found that all self-control construct components are positively associated with gender.

Our results do not contradict the statements of other authors about the links between self-control and various human characteristics [69].

The results of the linear stepwise regression analysis revealed that all the prediction models of the self-control construct components include emotional intelligence component optimism and gender. The utilization component is one of the predictive components in models for predicting self-discipline, work ethics, and reliability components. None of the prognostic models contain all the components of the emotional intelligence construct.

The results we obtained differed in some cases from those of other investigators, presumably due to the specific sample of subjects [2,5,7,8,21,43,54,56,57,64]. Student athletes do not represent all young people of a similar age. On one hand, this is a limitation of the study, but on the other hand, it allows a deeper study of the sample of interest to the researchers. The proposed prediction models can be useful for coaches and other sports professionals. Coaches knowing the indicators of an emotional intelligence can provisionally predict the self-control features of their trained youngsters. With data on emotional intelligence, health behavior among university students can be predicted [70]. There are also the new methodologies for predicting promising athletes using an individual

characteristics and a Bayesian analysis [9] and predicting using models based on machine learning algorithms [71].

Based on the results obtained in the study, it can be stated that the statements made in the hypothesis partially were confirmed, except for the case of the self-discipline component of the self-control construct, for which the estimates of female and male did not differ significantly.

Future research would be interesting to reveal how belief in the unlimitedness of willpower resources, and the belief that willpower resources are depleted through self-control, affect athletes' performance in sports.

Limitations and Strengths

Several limitations of the study should be noted. The study was performed using self-report questionnaires, so the responses could be affected by the social environment. Data analysis was based on correlations and linear stepwise regression, which makes it difficult to formulate conclusions about causes and effects. The research was conducted out using self-report instrumentations and could, therefore, be influenced by the psychosocial environment of the participants. The study sample consisted of university student-athletes, but not young people of the same age as the subjects.

The advantage is that it extends the results of previous research related to emotional intelligence and self-control research. Both areas are explored quite extensively, but emotional intelligence and self-control in the common space are explored much less frequently. The novelty of this study is that it examined the association among emotional intelligence, self-control, and gender in a sample of university student-athletes. The study found significant correlations among emotional intelligence and self-control, and gender and that gender predicts the estimates of the components of the self-control construct in the student-athlete sample.

5. Conclusions

Significant differences were revealed in female and male university-student athlete assessments of the components of the emotional intelligence and self-control constructs, except for the self-control construct component self-discipline.

All components of emotional intelligence and self-control constructs with each other and with gender in the university student-athlete sample are significantly related. Gender is one of the most important predictors of the components of the self-control construct. The component optimism was included in all proposed prognostic models as only one of the components of the emotional intelligence construct. Each of the components of the emotional intelligence construct 'was included in at least one of the prognostic models.

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Article

Predictive Strength of Contextual and Personal Variables in Soccer Players' Goal Orientations

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Abstract: Psychological variables, such as perceived motivational climate, goal orientation, self-determined motivation, and personality, have an influence on sports success performance. This study aimed to examine the relationships among a set of psychological variables (perceived motivational climate, goal orientation, self-determined motivation, and personality) in male and female footballers. Participants were 167 footballers (106 male, 61 female), aged 12 to 26, competing with clubs in the Spanish Football League. They all took four questionnaires aimed at evaluating motivational climate, goal orientations, self-determined motivation, and personality. The analyses of correlation and regression showed statistically significant relations among the variables. Neuroticism and psychoticism negatively relate to mastery motivational climate, the best predictor of self-determined motivation. It was concluded that contextual variables carry more weight in predicting goal orientations and self-determined motivation among participant footballers.

Keywords: motivation; performance; team sport; psychology; self

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1. Introduction

Psychology has developed and consolidated its presence in the spectrum of the practice of competitive, professional, and amateur sports, and with it, the growth in the analysis of psychological variables in the sports context [1,2]. Within the sports context, motivation and its relation with sports performance have attracted the interest of numerous researchers [3], specifically with respect to the reasons individuals pursue certain goals [4]. For decades, the importance of this variable has been highlighted in the self-determination theory (SDT) of motivation [5,6], in which an explanatory model is postulated and widely used in sports psychology to provide answers regarding involvement in the performance of activities. SDT analyses the extent to which people engage with their actions through a high level of reflection and self-determined motivation. It establishes a continuum between demotivation or absolute lack of motivation and self-determined motivation [7]. The concept of self-determination has been widely used to explain sports behaviour [8]. This variable is measured through the self-determination index (SDI), and implies that high SDI scores have positive effects on the training practices of athletes [9].

The motivational processes that operate in the behaviours of athletes in different contexts have been explained mainly through SDT, but also through achievement goal theory [10,11]. Studies on achievement goal theory [12] have pointed to the importance of the motivational climate over self-determined motivation and development of positive behaviours. 'Motivational climate' [13] is a term that describes the environment created by the trainer, family, and environment in the sports context, distinguishing between perceptions of execution and the mastery climate. The motivational performance climate promotes social comparison as the basis for success, and the rewards are based on the demonstration of superior performance [14]. In the mastery climate, trainers promote satisfaction, interest, and intrinsic motivation [14] or self-determined motivation [15].

Similarly, achievement goal theory [12] relates the perceived motivational climate to athletes' goal orientation. At least two goal orientations are assumed to exist, namely, a task (or mastery) orientation, in which competence is defined in terms of self-referenced criteria, and an ego orientation, which defines competence using external comparison criteria. The relevance of these goal orientations is demonstrated in sport, associated with different cognitions and behaviours, in which improving, learning, or mastering a task is the goal of task-oriented people, as opposed to ego-oriented ones, who pursue social approval and perform external tasks for results [16].

In the present study, we aimed to incorporate the importance of personality in the sports field, as great effects have been observed between personality, success, and sports progression [17,18]. For example, personality profiling in sport has been shown to be beneficial with established athletes [19] and, in turn, facilitates the transition of individuals from youth to adult teams [20]. To study how this variable acts as a modulator of goal orientation and to observe its relation with motivational climate and self-determined motivation, we used the three-dimensional personality model of Eysenck [21], in which two personality dimensions can be distinguished—extroversion–introversion and neuroticism–stability. A third dimension with independent functionality, called psychoticism, is also covered. This model is of a psychobiological rather than contextual character; thus, a priori, its study seemed interesting in relation to contextual variables within the sports environment. According to this model, an individual with high scores in neuroticism refers to an anxious, emotional person with a tendency to worry, whereas low scores characterize emotionally stable people, who easily identify their emotions, are responsible, and have flexibility to change. Along these same lines, a high score in extroversion is associated with greater sociability, little tendency to remain alone, and preference for strong emotions and optimism, whereas low scores imply withdrawal and inability in social skills. Finally, low scores in the psychotic dimension determine a tendency for dependence and the inability to act in decision making, in contrast to high scores, which characterize insensitive, inhuman, antisocial, violent, aggressive, and extravagant people [21]. These general characteristics create a psychological system produced by the interaction and subsequent adaptation between the individual and the environment [22]. In sports, such an interactive process takes place in the same way, where personality development is generated by the interaction between an individual's genetics and the environmental influence of physical activity [23], producing a bidirectional association between an athlete's personality and sports practice [24]. According to this bidirectional hypothesis [23,24], personality traits are influenced by the practice of sport (i.e., by contextual variables), as the athlete's adaptation to his or her sporting environment becomes important.

Within this frame of reference, the objectives of this study were to analyse the relationships among perceived motivational climate, self-determined motivation, goal orientations, and personality in a collective sport, such as soccer, to determine whether these variables have a predictive weight vis-à-vis the others and to examine differences in the aforementioned variables by gender (men and women) and category of sports.

2. Materials and Methods

2.1. Participants

A total of 167 footballers (106 males and 61 females), between 12 and 26 years old (M = 15.53 years, s.d. = 2.78 years), who belonged a to soccer team (47 children's category (12–13 years old), 41 cadet (14–15 years old), 28 youth (16–18 years old), 47 professional categories (>18 years old)) participated in this research.

2.2. Instruments

The information was gathered using five types of specialised and validated surveys (PMCSQ-2, POSQ, PLOC, Junior, EPQ-J and Adult, EPQ-A):

- Perceived Motivational Climate in Sports Questionnaire-2 (PMCSQ-2). To measure perceptions of motivational climate, the Spanish-adapted version of PMCSQ-2 New-

ton [25] was used. The adapted version, constituted by two factors, called mastery and execution [26], consists of 33 items: 17 items for mastery climate (e.g., the main thing is to improve) and 16 items on execution climate (e.g., the trainer only looks at the best), with a Cronbach's alpha value of 0.84. The response mode is Likert type, with scores ranging from 1 (strongly disagree) to 5 (strongly agree). In the present study, Cronbach's alpha values of 0.84 for the mastery climate and 0.87 for the execution climate were obtained.

- Perception of Success Questionnaire (POSQ) [27]. This scale consists of 12 items: six goal-to-task orientation items (e.g., demonstrates clear personal improvement), and six ego or result orientation items (e.g., I am clearly better than the others). The questionnaire is answered on a Likert scale, with scores ranging from 1 (totally disagree) to 5 (totally agree). In the present study, Cronbach's alpha values of 0.76 for task orientation and 0.85 for ego orientation were obtained.
- Perceived Locus of Causality Scale (PLOC) [28]. The adapted version consists of 20 items (four per factor) that measure intrinsic motivation, identified regulation, introjection, external motivation, and demotivation [29]. The scale is headed by the statement "I participate in the training sessions..." and is answered through a Likert-type scale from 1 (totally disagree) to 7 (totally agree). The scores obtained were used to calculate the SDI: [(2 × intrinsic motivation + identified regulation) − [(introjected regulation + external regulation)/2 + 2 × demotivation)] [30]. In the present study, the SDI yielded a Cronbach's alpha value of 0.79.
- Eysenck Personality Questionnaire (Junior, EPQ-J and Adult, EPQ-A) [21]. This is a questionnaire of individual or collective application, aimed at respondents aged 8 to 15 years (EPQ-J) and 16 years and older (EPQ-A). Its purpose is to evaluate the three personality dimensions of neuroticism, extroversion, and psychoticism. The youth version has 81 items and the adult version has 92. In both versions, the answer options are dichotomous (yes/no). In the present study, Cronbach's alpha values in EPQ-A of 0.81 for neuroticism, 0.67 for extraversion, and 0.70 for psychoticism were obtained. For EPQ-J, values of 0.78 for neuroticism, 0.65 for extraversion, and 0.70 for psychoticism were obtained.

2.3. Procedure

Athletes completed the questionnaires, following the same instructions, at the facilities provided by the soccer clubs. Collaboration was requested; we asked them for sincerity, reflection, and attention to each of the questions. Informed consent was obtained from the parents or guardians of underage athletes prior to completion of the questionnaires applied in the study. Participation was voluntary and all information was treated confidentially and anonymously. The application was carried out individually or in a small group, always face-to-face, depending on the availability of the athlete and the club, and always under the supervision of the authors of the study.

2.4. Data Analysis

The data were analysed using SPSS 25.00 (IBM, Armonk, NY, USA). Descriptive analyses and bivariate correlations were performed for each of the eight variables: neuroticism, extroversion, psychoticism, mastery climate, execution climate, ego orientation, task orientation, and SDI. To analyse differences by gender and category, multivariate analyses of variance were carried out (taking gender as an independent variable in the first position and the sports category in the second position). Finally, to study the extent to which personality variables and perceived motivational climate predict goal orientations and self-determined motivation, a hierarchical regression analysis was performed using the stepwise method.

3. Results

3.1. Descriptive Statistics and Bivariate Correlations

The means and standard deviations for all variables are presented in Table 1.

Table 1. Descriptive analyses and bivariate correlations.

	M	DT	1	2	3	4	5	6	7
1. Neuroticism	9.11	4.79	1						
2. Extroversion	17.37	4.12	−0.32 **	1					
3. Psychoticism	3.86	3.18	0.45 **	−0.19 *	1				
4. Mastery climate	4.30	0.49	−0.26 **	0.17 *	−0.16 *	1			
5. Execution climate	2.43	0.67	0.32 **	−0.15	0.18 *	−0.52 **	1		
6. Ego orientation	3.26	1.00	0.21 **	−0.06	0.21 **	−0.26 **	0.40 **	1	
7. Task orientation	4.60	0.47	−0.05	0.04	0.02	0.29 **	0.02	0.22 **	1
8. SDI	8.41	2.40	−0.17 *	0.14	−0.21 **	0.50 **	−0.36 **	−0.16 *	0.35 **

Legend: M = mean, s.d. = standard deviation. Note: * $p < 0.05$, ** $p < 0.001$.

After analysis, the following relations were found to be statistically significant. Neuroticism was positively related to psychoticism, and both were negatively related to extroversion. Psychoticism and neuroticism were positively related to the execution climate and goal orientation towards the ego; they were negatively related to mastery climate and SDI. Mastery climate was negatively related to execution climate and goal orientation to the ego, and positively to goal orientation to the task and SDI. For its part, execution climate was positively related to goal orientation to self and negatively related to SDI.

3.2. Gender and Category Differences

When a 2 (gender: 1 = male, 2 = female) × 5 (category: 1 = children, 2 = cadet, 3 = juvenile, 4 = senior 5 = 1st Division) multivariate analysis of variance was performed, a significant multivariate effect emerged for gender, $\lambda_{Wilks} = 0.872$, $F(8,124) = 2.27$, $p < 0.05$, $\eta^2 = 0.13$. Meanwhile, univariate analyses showed differences in the mastery climate, $F(1,140) = 5.38$, $p < 0.05$, $\eta^2 = 0.04$, where females scored higher than males. Regarding the execution climate, $F(1,140) = 5.33$, $p < 0.05$, $\eta^2 = 0.04$, and ego orientation, $F(1,140) = 9.23$, $p < 0.05$, $\eta^2 = 0.07$, males scored higher than females. A significant multivariate effect also emerged for the category $\lambda_{Wilks} = 0.655$, $F(32,458) = 1.74$, $p < 0.01$, $\eta^2 = 0.10$.

Univariate analyses showed differences in extroversion, $F(1,140) = 8.86$, $p < 0.001$, $\eta^2 = 0.21$; that is to say, as the category in which they play progressed (from children to professional), the score on this variable decreased. Finally, no significant differences were observed in gender interaction by category $\lambda_{Wilks} = 0.799$, $F(24,360) = 1.74$, $p = 0.23$, $\eta^2 = 0.07$.

3.3. Hierarchical Regression Analysis

To determine whether the predictive value of personal goal orientation is greater depending on personal or contextual characteristics, a regression analysis was carried out in successive steps (Table 2). Personality variables were introduced, followed by motivational climate variables. SDI was also included as a dependent variable. Of the three dependent variables analysed, only neuroticism predicted ego orientation in step 1; it then disappeared in step 2. The most important predictor of this variable was the execution climate; whereas for task orientation and SDI, the most important predictor was the mastery climate. Thus, contextual variables were the ones that could predict these dependent variables.

Table 2. Hierarchical regression analysis (dependent variables: target orientations; independent variables: personality variables, dimensions of motivational climate, and SDI).

		Ego		Task		SDI	
	Variables	**B**	**R^2**	**B**	**R^2**	**B**	**R^2**
Step 1	Neuroticism	0.040 *	0.032	−0.096	0.013	−0.069	0.044
	Extroversion	−0.030		0.050		0.108	
	Psychoticism	0.034		0.089		−0.104	
Step 2	Neuroticism	0.032	0.174	−0.088	0.154	0.059	0.274
	Extroversion	−0.002		0.029		0.075	
	Psychoticism	0.027		0.099		−0.081	
	Mastery climate	−0.125		0.438 ***		0.390 ***	
	Execution climate	0.530 ***		0.270 **		−0.177 *	

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4. Discussion

Derived from the study of correlation between the study variables, statistically significant relations were found. Within the framework of the theory of motivational climate achievement goals [25], the dimensions of climate, mastery climate (involvement in the task), and execution climate (ego-centred) were included. The results indicated that both types of climate correlated negatively at the opposite end of a continuum. However, given the negative correlation between mastery climate and execution climate, it is appropriate, in a collective sport such as soccer, to enhance the climate of mastery, especially because the presence of a climate of execution would imply the predominance of individual objectives focused solely on the self [31]. The results of the relation between motivational climate and goal orientations indicated that mastery climate was positively related to goal orientation to the task and negatively related to goal orientation to the ego [32]. Thus, the socialization or climate generated by the trainer and the environment has important implications for the way to interpret success and define competence (strengthening goals directed towards the task when the climate favours it). In contrast, execution climate did not show a significant relation with goal orientation to the task. The explanation could be related to personal predisposition (centred on the self or ego), which, to a great extent, would determine the a priori probability of adopting a concrete goal and of representing a pattern of behaviour [33]. These relations confirm the need to promote a motivational climate of mastery in a team sport such as soccer, which will be related to goal orientations to the task more than to individual ones. Therefore, the facets related to the type of goal orientation would be those included in the most adaptive social pattern. When the practice of sports, for example, becomes professional or competitive, a progressive increase in the execution climate would be observed owing to greater rivalry associated with extrinsic goals of greater strength [11].

The results of the correlation analysis showed significant relations between the motivation and variables such as personality dimensions and SDI. Specifically, the mastery climate showed a statistically significant positive relation with SDI (as opposed to the execution climate, whose statistical relation was negative). It should be noted that high SDI scores have numerous positive implications for athletes' training practices [34,35]. Likewise, we found that psychoticism and neuroticism were positively related to the execution climate and goal orientation towards the ego, whereas both negatively predicted a mastery climate [36]. All these data, as a whole, showed that these two personality variables negatively affected both self-determined motivation and the climate of mastery, and consequently, task orientation. This tendency may hinder sporting success; variables such as neuroticism are lower in professional athletes [37].

Regarding personality variables, neuroticism was significantly and positively related to psychoticism, and both showed a significant and negative association with extroversion. These results confirmed those in similar studies, in which athletes scored high in extroversion and low in neuroticism, leading to the negative relation between these variables [38]. One aspect to comment on is the relative proximity between the scales of neuroticism and

psychoticism. This proximity could be explained by considering that the aspects shared by both dimensions are closer to the extroversion dimension [39]. Likewise, psychoticism and neuroticism correlated positively with execution climate and ego orientation, and negatively with mastery climate and SDI. In the same way, SDI had a positive relation with task orientation and a negative relation with ego orientation. Therefore, these two personality variables would negatively affect the self-determined motivation, climate of mastery, and task orientation.

The results of the regression analysis supported the findings described above. Thus, neuroticism initially predicted an ego-centred orientation, whereas mastery climate predicted a task-centred orientation. Furthermore, neither neuroticism nor psychoticism showed a predictive power over SDI, but mastery climate did predict this variable (SDI). It should be pointed out that self-determined motivation is also relevant outside the sports field, given that it is related to a reduction in depressive symptoms [40].

As previously stated, contextual and dispositional variables in the sports context are related in the so-called bidirectional hypothesis [23]. According to this hypothesis, certain personality traits increase with the regular practice of sport, but sports performance also contributes to personality enrichment [24]. To delve more deeply into this two-way influence, regression analysis was used to analyse whether contextual variables predicted personal variables, or if the opposite occurred. The results indicated that both mastery climate and execution climate could predict SDI (with a greater significance in the case of mastery climate), thereby leading to the conclusion that the contextual variables had greater weight in the relationship. Based on these results, it is clear that the coach can have a positive impact on the intrinsic motivation and personality dimensions, and as such, the value of this variable must be emphasised.

Furthermore, gender and category differences were analysed. With respect to gender, a general tendency was observed in women, who obtained higher scores in the mastery climate than men. Meanwhile, the men scored higher in the execution climate and ego orientation. The differences obtained can be explained by social factors. Women tend to interpret sports in a cooperative and leisure context, as opposed to men, for whom the competitive aspect in sports seems predominant [41]. With respect to this last dimension of personality, extroversion decreased in both genders as the category in which they played progressed. From this, it is inferred that the longer they practice sports, the less extroversion they would show. This relation differs from findings in earlier studies: sports practice is associated with extroversion [42], athletes score high on extroversion [38,43], and athletes in collective sports are more extroverted [37]. In any case, influences on sports participation are well established [44], and personality interacts with environmental changes, affecting participation in sport and physical activity. For this reason, it is necessary to emphasise that the present participants were footballers of diverse categories. All belonged to professional clubs of the Spanish soccer league, in which, beginning in the initial categories, the footballers not only compete with external teams but also with members of their own team or companions (to enjoy more minutes, more matches, promotion, etc.). This context influences the different dispositional variables of the sportsman [31], as happens with extroversion, as the player advances to higher categories.

Finally, it is important to point out certain limitations of the present study, such as sample size, which, in some of the categories, was small. A greater number of participants would make it possible to specify the differences according to degree or professional level. Moreover, no measure of performance was included. It ought to be noted that participants of many different ages were surveyed for this study. Not all of them played at a professional level, which might influence our interpretation of the results. Thus, a future line of interest is to deepen the relationships between the variables studied here through longitudinal studies, which could further explore influential or predictor variables of sporting success, such as psychological constructs or sociodemographic, familiar, or academic variables.

5. Conclusions

The team environmental and leadership variables will configure a type of goal orientation and affect additional personality factors. Based on the results of this study, it seems obvious that the coach has a positive influence on intrinsic motivation and on the personality dimensions. It is, therefore, necessary to emphasize the value of this variable. This may result in a series of consequences, which play an important role as transmitters of values, attitudes, and behaviours and could have an impact on sports performance. Data found in this study could be used to create new psychological interventions with aims to enhance soccer development.

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Article

Personality Determinants of Success in Men's Sports in the Light of the Big Five

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Abstract: The aim of the study is to describe personality profiles and determinants of success in sports in relation to the Big Five Personality Model. In order to achieve this aim, personality profiles of players from various sports disciplines was set against the personality profile of champions—players who are considerably successful in sports competitions. Subsequently, an attempt was made to determine which personality traits significantly determine belonging to the group of champions—and therefore determine success in sport. The participants were men aged between 20 and 29 from the Polish population of sportsmen. A total of 1260 athletes were tested, out of whom 118 were qualified to the champions sample—those athletes had significant sports achievements. The research used the NEO-FFI Personality Questionnaire. Basic descriptive statistics, a series of Student's *t*-tests for independent samples using the bootstrapping method, as well as a logistic regression model were performed. In relation to other athletes, champions were characterized by a lower level of neuroticism and a higher level of extraversion, openness to experience, agreeableness, and conscientiousness. An important personality determinant was neuroticism: the lower the level of neuroticism, the greater the probability of an athlete being classified as a champion. There are differences between champions and other athletes in all personality dimensions in terms of the Big Five. Based on the result of the research, it can be stated that personality differences should be seen as a consequence of athletes' success, rather than as a reason for athletes' success, based on their age between 20 and 29.

Keywords: sport psychology; personality; neuroticism; champions

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1. Introduction

A problem that has long been of interest to sports psychologists, coaches, and athletes alike concerns the determination of the personality traits of a champion [1,2]. This particular task would involve the identification of the athletes' personality traits which are essential to their success in sport [3,4].

For instance, Garland and Barry [5] carried out an experiment on American college athletes, varying in terms of physical fitness and sport level, to test the relationship between personality as measured by the 16-Factor Personality Questionnaire and their sports performance. It was shown that personality traits such as belief rigidity, extraversion, group dependence, and emotional stability were responsible in 29% for variations in physical fitness. Davis [6], in turn, tried to predict the success of professional hockey players by measuring their personality traits, but found no correlation. He believed that success was influenced by more important psychophysical factors.

In another study, Lerner and Locke [7] measured the willingness of American college athletes to compete in relation to their achievement motivation. To this end, they used the Sports Orientation Questionnaire, and measured their endurance by performing squats. Similarly, as in Garland and Barry [5], a relationship was found between personality and

success. Psychological factors such as goal setting and self-efficacy have been shown to validate the influence of personality on athletic performance.

In a cutting-edge experiment by Piedmont, Hill, and Blanco [8], four different Division 1 NCAA soccer teams were tested with the Big Five model. Coach ratings for several dimensions of player performance and actual game statistics were also collected. Regression analysis indicated that personality dimensions of neuroticism and conscientiousness explained about 23% of the coaches' variance ratings, while conscientiousness was the only predictor of actual game statistics, explaining about 8% of the variance.

A slightly different research was carried out by McKelvie, Lemieux, and Stout [9] on groups of university athletes (divided into contact and non-contact disciplines) and non-athletes, with the use of the Eysenck Personality Inventory. Extraversion did not differ significantly between athletes and non-athletes, nor between contact and non-contact sportsmen, but was higher for athletes in general compared to American academic standards. In the case of neuroticism, successful athletes scored significantly lower than unsuccessful athletes. As neither extraversion nor neuroticism results has changed over the four years of continuous research, one might conclude that people with higher extraversion and lower neuroticism are interested in academic sports.

In another study Anghel, Banica, and Ionescu [10] found out that personality traits of elite athletes were dependent and distinctive of the sports discipline they trained. The athletes were characterized by low neuroticism, high extraversion, and conscientiousness, but the intensity of individual personality traits depended on the trained sport discipline. This indicates the existence of a general personality profile of athletes, in which the strength of the acceleration of personality traits is determined by particular sports disciplines.

Mirzaei, Nikbakhsh, and Sharififar [11] made further attempts to investigate the relationship between personality traits and sports performance in the Big Five model. The research sample included more than 200 non-elite soccer players and futsal soccer players. It was shown that among the personality traits, only conscientiousness had a significant correlation with sports performance—conscientiousness alone was the only predictor of sports performance.

Then, Kim, Gardant, Bosselut, and Eys [12] conducted an experiment on a sample of team sports players and showed that low neuroticism, high extraversion, and conscientiousness all influence informal role-taking in a sports team, depending on the sports team. The same year, Steca, Baretta, Greco, D'Addario, and Monzani [13] examined more than 800 athletes and non-athletes with the use of the Big Five model. It was shown that the most successful athletes in their discipline had higher scores than the non-athletes in every dimension of the Big Five, except neuroticism, in which they scored lower. In contrast, less successful athletes outperformed the non-athletes only in extraversion and agreeableness. Athletes who were more successful in their competitive sports (champions) showed greater emotional stability (lower neuroticism), extraversion, openness to experience, agreeableness, and conscientiousness than less effective athletes. Moreover, individual athletes turned out to be more energetic and open-minded than team athletes. In another study, Piepiora and Witkowski [14] tried to generate psychological personality profiles of athletes performing individual and team disciplines, depending on the type of pressure exerted on the opponent in the starting situation. Differences were found in the scales of neuroticism and conscientiousness between sports disciplines in which pressure is exerted indirectly on the opponent, and disciplines in which the pressure exerted directly on the opponent. The study groups, with the exception of volleyball players and football players, differed from each other in terms of neuroticism scale, while the volleyball players showed less agreeableness and conscientiousness than other athletes.

Taking the above research and reflections as the starting point for the research problem formulation, it should be assumed that personality conditioning in sports champions in relation to the population of unsuccessful athletes, according to the Big Five model, focuses on lower neuroticism and higher extraversion, openness to experience, agreeableness, and conscientiousness [15,16]. However, there is ambiguity in relation to the type of sport,

competing classes, or cultural affiliations. Personality traits are adequate to the specificity of the trained sports discipline, and its goals and challenges. The personality profiles of the athletes are at similar levels, but they are not identical. Among athletes, it is extremely difficult to distinguish and define the most favorable type of personality, as it is largely influenced by the trained sports discipline, and it determines the personal conditions of athletes [17–20]. Therefore, it was deemed necessary to verify which personality traits, and to what extent said traits, define sports champions and determine success in sports.

The research problem was an attempt at defining personality profile of sports champions and personality determinants of success in sport in the light of the Big Five factor model. In connection with the above, personality profiles of players from various sports disciplines in the areas of combat sports [21], individual sports [22], and team sports [23] were compared with the personality profile of champions [16]—players who are very successful in sports rivalry. Subsequently, attempts were made to determine which personality traits significantly determine belonging to the group of champions—and thus determine success in sport. For this purpose, the Big Five model was used, as it does not transgress the definition of personality traits understood as behavioral properties, showing interindividual variability and intra-individual temporal and situational permanence. They adopt a number of methodological assumptions that define the status of personality traits as "basic" dimensions of personality. The Big Five model defines the most general characteristics of behavior that are actual, invariant, universal, and biologically conditioned [24].

2. Methodology

2.1. Participants

The research was carried out between 1 October 2015 and 30 September 2019. The subjects of the study were men, intentionally, non-randomly selected from the Polish population of sportsmen. The criteria for the non-random, purposeful selection of respondents were: free will to participate in the study; senior age (between 20 and 29 years of age); at least the second or higher sports class; many years of sports experience—three years or more; a current competition license; and documented sports achievements at various levels of rivalry (national, continental, and world). A total of 1260 competitors were tested, 30 each from the following sports disciplines: alpine skiing, American football, archery, athletics—long runs, athletics—short runs, ballroom dancing, basketball, beach volleyball, biathlon, bodybuilding, Brazilian jiu-jitsu, break dance, canoeing, cycling, fitness, floorball, football, futsal, handball, horse riding, indoor volleyball, judo, ju-jitsu, kickboxing, kyokushin karate, mixed martial arts, mountaineering, Olympic karate, orienteering, Oyama karate, rugby, shidokan karate, shotokan karate, snowboarding, sport climbing, sport shooting, swimming, taekwondo, tennis, tobogganing, ultimate frisbee, and wrestling. Such a distribution of disciplines depended on the respondents' willingness to participate in the study. From the above population, 118 athletes were qualified to the sample of champions. Players with international sports successes were defined as champions. Therefore, the criterion for qualifying Polish players to the sample of champions was their 1st, 2nd, or 3rd place in international sports competitions. This includes medalists of the World Championship, the European Championship, the World Cup, the European Cup, the World Games 2017, and other ranked international tournaments in their sports disciplines. The following champions with significant sports achievements were identified: from alpine skiing (3), archery (5), ballroom dance (2), beach volleyball (2), biathlon (4), bodybuilding (4), Brazilian jiu jitsu (4), break dance (2), canoeing (2), cycling (2), equestrian (1), fitness (4), floorball (2), futsal (2), ju jitsu (5), judo (3), kickboxing (4), kyokushin karate (6), mixed martial arts (4), mountaineering (1), Olympic karate (1), orienteering (3), Oyama karate (4), shidokan karate (5), short (2) and long runners (8), shotokan karate (6), snowboard (3), sports climbing (3), swimming (3), taekwondo (5), target shooting (1), toboggan (3), volleyball (7), and wrestling (2). The other 1142 athletes were sportsmen with only national (Polish) sports successes. Only the best results of the respondents on the day of

the study were included in the study. The achievements of already tested players have not been updated.

2.2. Method

The NEO-FFI Personality Questionnaire was selected to examine the athletes' personality in terms of the Big Five factor model [25]. The selection criterion was justified by: the location of NEO-FFI in the theoretical model and relatively large methodological formalization compared to other approaches developed within the five-factor personality model; good psychometric characteristics; rich factual documentation of the measurement accuracy for the factors of the original version, which allows to assume that the inventory may be useful in scientific and practical research; and duration time acceptable for the athletes.

The items of the NEO-FFI Personality Questionnaire are formed by five scales measuring the factors of the Big Five model. They are marked with abbreviations of the first letters of the factors: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. For the purposes of this study, the acronym NEOAC was adopted, i.e., the above-mentioned sequence of factors.

The NEO-FFI Personality Questionnaire is internally consistent. Its validity was demonstrated on the basis of research on the relationship between the results of the questionnaire and the assessments of the subjects made by observers, the heritability of the measured traits, and their correlation with other dimensions of personality and temperament. The factor validity was also verified. The results allow for a full description of the respondents' personality in the five-factor approach of the Big Five and forecasting their adaptation possibilities to the professional environment [24,25]. Moreover, the NEO-FFI assumes a maximum examination time of one hour. Such duration of the study was acceptable to athletes who expressed free will to participate.

2.3. Data Analysis

In order to verify the research problem, statistical analyses were performed using the IBM SPSS Statistics, version 25 (IBM Polska, Warsaw, Poland). Beforehand, basic descriptive statistics were calculated for each sports discipline included in the study. It was decided not to calculate normal distribution tests for each personality trait in each discipline due to the relatively small sample size and the multiple comparisons. Both of these factors could render the conclusions drawn from the results of such tests incorrect. For this reason, the so-called the rule of thumb was used for the analysis of skewness value. If the skewness value for a given variable ranged from -2 to 2, then it could be concluded that the distributions of these variables are not too asymmetric, which allows for the use of parametric tests. In the case of differently classified data comparisons, the skewness values for the compared groups were checked before the analysis. Each time, they fell within the accepted range. In order to solve the research problem, Student's *t*-tests for independent samples and a logistic regression model were performed. This model presents an exploratory analysis to see how individual personality traits will predict belonging to the champion group. It was necessary as *t*-tests only verify differences in a single dimension.

2.4. Procedure

All respondents consented to the processing of data related to their participation in the research by the researcher.

The project received a positive opinion (number 20/2019) of the Senate Committee on Ethics of Scientific Research at the University School of Physical Education in Wrocław.

3. Results

The sample of champions consisted of 118 men (9% of the respondents), and the sample of other athletes, 1142 men (91% of the respondents). In order to verify the research

problem, a number of Student's *t*-tests were carried out for independent samples using the bootstrapping method, set at 10,000 samples and a 95% confidence interval. Five Student's *t*-tests were performed, and the statistical significance level for the analyses of variance was calculated as $\alpha = 0.01$.

The test results showed statistically significant differences in all personality traits from the Big Five model. In the case of neuroticism, a very strong difference effect persisted. A moderately strong effect was observed for extraversion and conscientiousness, and weak effects were observed for openness to experience and agreeableness. Sports champions were characterized by a lower level of neuroticism and a higher level of extraversion, openness to experience, agreeableness, and conscientiousness than the group of other athletes. The exact values of the performed tests are presented in Table 1. The samples are presented graphically in Figure 1.

Table 1. Analysis of differences between champions and other athletes in the intensity of personality traits.

	Other Sportsmen (n = 1142)		Champions (n = 118)				
Variables	**M**	**SD**	**M**	**SD**	***t***	***p***	**Cohen's *d***
Neuroticism *	15.30	5.58	5.58	2.56	33.79	<0.001	1.81
Extraversion	30.98	5.75	34.13	5.80	−5.65	<0.001	0.55
Openness to experience	25.54	5.87	28.28	5.79	−4.83	<0.001	0.47
Agreeableness	27.91	5.99	30.20	6.78	−3.91	0.001	0.38
Conscientiousness	34.06	6.33	38.56	5.82	−7.40	<0.001	0.72

* correction for heterogeneity of variance; *t*—t statistic value; *p*—significance level; and Cohen's *d*—a measure of the size of the effect.

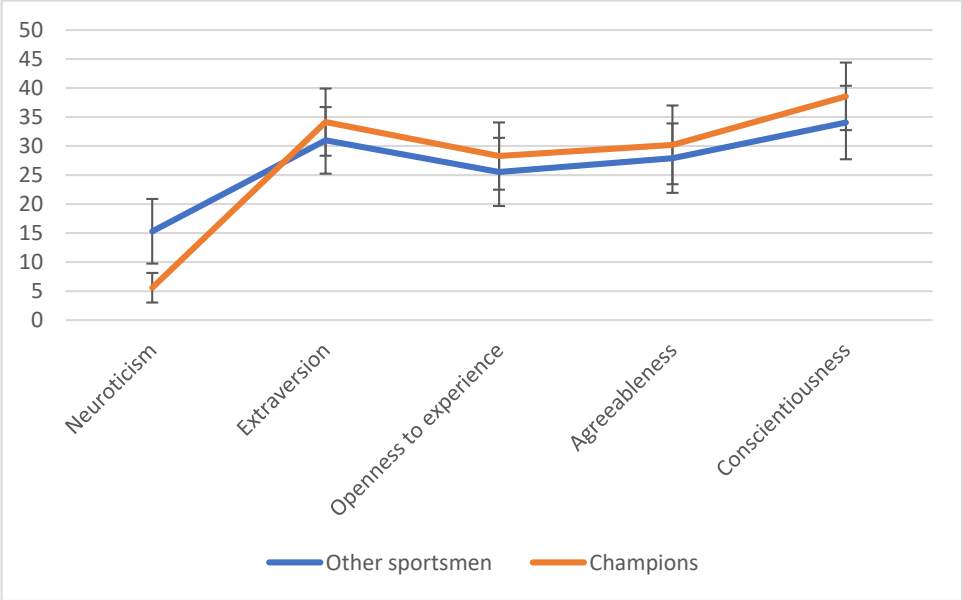

Figure 1. Line graph of personality profiles; breakdown into champions and other athletes.

Finally, in order to verify the analyzed results, a logistic regression model was prepared where, based on personality traits, an attempt was made to classify the respondents into the group of sports champions and other athletes.

In the first step, all personality traits were introduced as predictors of the athletes' level. The null model was characterized by 90.6% correct classifications, which results from the ratio of the number of other athletes to all research subjects. The classification threshold, based on the ROC analysis, was set to 0.7. The model with five predictors was statistically

significant χ^2 (5) = 425.68; $p < 0.001$, and Nagelkerke's pseudo-R^2 was 0.62, which means that the proposed model explains about 62% of the variance. The Hosmer–Lemeshow goodness of fit test was statistically insignificant χ^2 (8) = 7.49; $p = 0.485$. The entire model correctly classified 94.3% of the observations. The analysis of the significance of the predictors in the discussed model showed that only neuroticism significantly predicted belonging to the champions group or to the other athletes group. For this reason, another model was created in which neuroticism was the only predictor. The second model was statistically significant χ^2 (1) = 423.02; $p < 0.001$, and Nagelkerke's pseudo-R^2 was 0.62. The goodness of fit test was again statistically insignificant χ^2 (7) = 13.44; $p = 0.062$. The overall percentage of correct classifications was also 94.3%. Pseudo-R^2 for one personality variable of logistic regression was 62% of the variance as other athletes are very different from the champions in their level of neuroticism. In the *t*-test analysis, the effect size was $d = 1.81$, which is a very high result. It is rarely seen, but apparently the two groups are quite different in this respect. The other personality measures did not contribute to the percentage of explained variance. Therefore, the second model, with the only predictor being the neuroticism measure, turned out to be as good as the model with five predictors. This means that neuroticism was the key personality trait that predicted the level of achievement among the tested athletes. A relationship was established in the developed model: the lower the level of neuroticism, the greater the probability of being classified as a sports champion. The relationship is presented in Table 2.

Table 2. Coefficients of the logistic regression model predicting classification to sports champions group or other athletes group, based on personality traits.

Explained Variable		β	β SE	Wald's χ^2	p	e^{β}	R^2
Other sportsmen vs. Champions	(Constant)	2.21	1.38	2.57	0.109	—	0.62
	Neuroticism	−0.67	0.06	124.99	<0.001	0.51	
	Extraversion	0.02	0.3	0.79	0.375	1.02	
	Openness to experience	−0.01	0.02	0.06	0.807	0.99	
	Agreeableness	<0.01	0.02	<0.01	0.952	1.00	
	Conscientiousness	0.03	0.02	1.23	0.267	1.03	
Other sportsmen vs. Champions	(Constant)	3.96	0.44	81.34	<0.001	—	0.62
	Neuroticism	−0.68	0.06	136.64	<0.001	0.51	

β—non-standardized Beta coefficient; β SE—standard error for the Beta coefficient; Wald's χ^2—chi-square statistics for Wald test; e^{β}—odds ratio; and R^2—statistics of model fit to data ($R^2 \times 100\%$—percentage of explained variance).

4. Discussion

The analyses showed statistically significant differences in all personality dimensions in the Big Five five-factor approach; namely: sports champions were characterized by a lower level of neuroticism and a higher level of extraversion, openness to experience, agreeableness, and conscientiousness than other athletes. This personality profile of sports champions confirmed earlier research reports [16,21–23,26], and at the same time negated the research of Mirzaei and colleagues [11], which suggested that only high conscientiousness correlated with sports results.

Whether the personality determinants of success in sport were formed solely in the course of many years of sports career, or already at the beginning of sports practice still remains an open question. Therefore, the opinion of respected scientists such as Allen [17–20], or Vealey [27] cannot be ruled out. Factors disrupting or supporting the development of a young athlete are created by his immediate environment. This, in turn, is expressed in self-esteem, which has a significant impact on the shaping of the personality and competences of talented players.

The logistic regression model analyzed the obtained results. On the basis of the five-factor personality model, attempts were made to classify the researched population into the group of sports champions or the other athletes group. The research results have shown

that neuroticism was an important personality trait, allowing to classify athletes according to their level of sports achievements; the lower the level of neuroticism, the greater the probability of being classified as a sports champion. The numerous relationships found in the research between personality dimensions and athletes in various randomizations allow us to conclude that the results concerning neuroticism as a determinant of personality success in sport are highly probable and may be universal. The only predictor of sports results, and thus a personality determinant of success in sports, in terms of the Big Five, was neuroticism.

The dimension of neuroticism reflects emotionality in terms of experiencing negative emotions, i.e., emotional adaptation in relation to emotional imbalance. The sports champions were distinguished by very low neuroticism, thus it can be assumed that they were emotionally stable, calm, relaxed, and able to deal with stress without experiencing anxiety, tension, and irritation; whereas other athletes had a higher level of neuroticism compared to the champions. This means that their negative emotions influenced their adaptation to the environment. Neurotic people were prone to irrational ideas, and relatively inadequate to control their drives and cope with stress. This is due to the general excitability of the vegetative system. The reactions are too great in relation to the strength of the acting stimuli. Emotionally unstable competitors experience very strong pre-start conditions and can collapse in the face of important competitions. It can be expected that in difficult situations, their efficiency of perception, speed and accuracy of sensorimotor responses, efficiency of thinking processes, and the quality and effectiveness of action will deteriorate significantly. The dimension of neuroticism includes six formally distinguished components: anxiety, aggressive hostility, depression, impulsiveness, hypersensitivity, and excessive self-criticism. Therefore, champions may be distinguished from other sportsmen by low level of anxiety, which has a positive effect on motivation [6]; low aggressive hostility that triggers the state of start readiness, which translates into the control of arousal before and during the competition, and bravery understood as fighting until the very end [28]; low depressiveness that indicates an optimistic mood and a positive attitude [29]; low impulsiveness that crystallizes emotion control [30]; low hypersensitivity that gives good concentration of attention and the need for strong sensory impressions, as well as the ability to cope with failure and experience success [31]; and finally, low self-criticism that determines self-confidence and self-efficacy [32].

Taking the above into consideration, the greatest cognitive value of this paper is to prove that neuroticism is an important personality condition for success in sport. Therefore, one should adopt broad perspectives of analyses of neuroticism components as mental determinants of sports success. As there is no data regarding whether social factors influence the personality of the surveyed sportsmen, one should also pay attention to the role of the social environment of sportsmen. This knowledge may be useful in the detection and proper development of sports talents, modernization of sports training and better adaptation of athletes to the environment after the end of their career. It is also important to notice that sports activities shape the personality of players [1–4,33]. Therefore, the differences in personality shown in this study can be seen as a consequence of the athletes' success, rather than as a reason for athletes' success, based on their age between 20 and 29. Sports activity could be seen as a self-confidence generator. Under the influence of trainings, adepts start to improve in a given discipline, and this moderates their personalities. Athletes become convinced that they are the authors of their own fate and that they create their own lives. This is why the successes achieved by the players build strong personalities of athletes.

The obtained research results also provide a new argument about the health aspects of sports training (in the context of health through rational, long-term sports training) in personality development. There are few empirical studies on the relationship of motor, technical and tactical training, and the results of personality tests. Hence, the possibilities of a broader interpretation of research results from an interdisciplinary perspective are limited.

At this point, the strengths and limitations of the conducted cognitive experiment should be equally noted. The research sample was homogeneous in terms of ethnicity, gender, and the age range of 20–29 years. Athletes of other nationalities, women, and other age groups were not included. The research was conducted on a large group of respondents from sports disciplines popular in Poland. However, it was not possible to examine athletes from all sports disciplines trained in Poland. The group of champions included Polish athletes with international sports successes. Therefore, the obtained research results can only be applied to a specific population of athletes. Thus, the following conclusion can be drawn: a low level of neuroticism is a personality determinant of success in sport among Polish male athletes between the ages of 20 and 29. However, one must bear in mind that the personality determinants of success in sport in various disciplines are distinct. This is due to the specificity of sports competition in martial arts [21], individual [22], and team [23] sports, as well as different psychological requirements they place on competitors [1,33].

However, the general personality profile of athletes in terms of the Big Five is low neuroticism, high extraversion and conscientiousness, average openness to experience and agreeableness [4,17]. In comparison with the reports by Allen [20], it was noticed that low neuroticism also has a significant role in the personality differentiation of champions from the rest of the athletes. It has been proven that a low level of neuroticism may be a personality determinant of sport success among Polish athletes between the ages of 20 and 29, and its intensity depends on the sports discipline. It is therefore suggested that the coaches analyze the personality conditions of the players for sports competition, as these have a significant impact on the sports results. Hence, in sports theory, one should adopt broad perspectives of personality component analyzes as mental determinants of sports success.

5. Conclusions

There are differences between champions and other athletes in all personality dimensions in terms of the Big Five. Sports champions were characterized by a lower level of neuroticism and a higher level of extraversion, openness to experience, agreeableness, and conscientiousness in relation to other athletes. Analysis of the obtained data by the logistic regression model proved that only neuroticism was an important personality determinant predicting the level of achievement among the studied athletes: the lower the level of neuroticism, the greater the probability of classifying the athlete to the champion group. Champions are presumably balanced and usually resistant to stress. They are not very sensitive to various stressors. They have better attention span, and they do not panic in difficult situations. Their well-being is stable, and their emotional reactions are adequate to the stimuli. Therefore, sports development of athletes without the knowledge of the specific features and personality structure of various sports representatives may be an artificial and ineffective activity. It remains an open question whether the personalities of the champions were shaped only in the course of many years of their sports career, or whether they already distinguished champions at the beginning of their sports practice. Therefore, based on the result of the research, it can be argued that personality differences should be seen as a consequence of the athletes' success, rather than as a reason for the athletes' success, based on their age between 20 and 29.

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Article

Sleep Quality in Chilean Professional Soccer Players

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Abstract: Recent research has shown that good sleep quality has a positive effect on physical performance. However, sleep quality in Chilean professional soccer players is unknown. The purpose of this study was to determine sleep quality in Chilean professional soccer players. It was a cross-sectional, explanatory study with observable variables. The sample consisted of 94 Chilean male soccer players belonging to four professional clubs. The main variable was the Sleep Quality Index, evaluated through the Pittsburgh questionnaire (Spanish version). After estimating sleep quality individually, the four professional soccer clubs' comparison was performed through a one-factor ANOVA. The Pearson test was used to relate the questionnaire variables; the significance level was $p < 0.05$. In the global analysis of the Pittsburgh Sleep Quality Index, a value of 4.75 ± 2.29 on a scale of 0–21 was observed, with no significant differences between the clubs evaluated ($p > 0.05$). Based on the results obtained, Chilean male professional soccer players present good sleep quality. However, the high values of "sleep latency" and "sleep disturbances" are indicators that should be worked on by the multidisciplinary team of each professional club. They should develop strategies to improve sleep hygiene, encourage good sleep, and fall asleep efficiently.

Keywords: sleep quality index; physical performance; professional soccer players

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1. Introduction

Sleeping is a fundamental biological and physiological need of the human being. In fact, good sleep quality is a relevant factor for correct organic functioning; sleeping is regulated by the hypothalamus and cannot be omitted without experiencing harmful consequences for people [1] since, among other actions, it allows regulating and restoring psychological and physical functions [2]. Likewise, due to the brain's multiple electrical activities during sleep, sleeping is considered a state of dynamic consciousness [3,4]. Specifically, the brain activity developed during the hours of sleep modifies the organism's functioning; body temperature, specific hormone levels, blood pressure, and respiratory frequency might change [5]. Consequently, these organic changes, the product of brain activity during sleep, intervene in energy restoration processes, learning, memory, and cognition [1,6], favoring a state of recovery of people [7]. However, despite the existing evidence, a considerable number of people sleep fewer hours than necessary (sleep restriction) and have a low sleep quality [8].

Both the experience reported by patients [9] and scientific evidence [10] have established that people should sleep between 7 and 9 h a day for good sleep quality. On the contrary, generating a sleep restriction below the recommended time range (7 to 9 h) could generate a poor sleep quality [11], affecting the health of both common people [12,13] and

elite athletes [14]. In recent years, it has been shown that poor sleep quality is associated with alterations in cognitive function, mood changes [15], endocrine system dysfunction [16], and depression of the immune system [17], among others [18]. Similarly, Spiegel et al. [19] showed that a four-hour daily sleep restriction for two consecutive nights reduced leptin levels and increased ghrelin levels in healthy adults; the researchers also associated these hormonal changes with an increase in hunger and appetite [19]. The latter could explain the modifications in body mass and overweight in people with sleep restrictions [20]. This background allows us to observe that sleep restriction, due to environmental factors, lifestyles, or diseases [21], affects the entire population [20,22–24].

There is evidence of deficiencies in the quality and quantity of sleep in elite athletes [14]. Specifically, Mah et al. [25] investigated the effects of sleep extension on sports performance, reaction time, mood, and daytime sleepiness in college basketball players, demonstrating that optimal sleep is probably beneficial for achieving maximum sports performance. Conversely, it has been established that poor sleep quality affects anxiety levels [26]; the latter condition is considered a negative emotion that decreases athletic performance [27], as it affects athletes' perception before a competition [26]. To mitigate sleep restrictions in elite athletes, generated by uncontrolled variables such as anxiety, and because high sleep quality is a critical component for sports performance [28], multidisciplinary teams have implemented sleep education and sleep hygiene methodologies [29–31]. However, before implementing sleep hygiene programs, sleep habits and sleep quality should be evaluated in different populations [32,33].

Sleep habits and sleep quality are well documented in the adult population [32] and some populations with special needs [20]. In this sense, and considering that elite athletes have been described as populations with special requirements and needs [34], sleep quality and hygiene have been a focus of attention [29–31]. Another critical factor within sleep hygiene, which has also been extensively studied, is the circadian cycle [35,36]; indeed, there is strong evidence linking disrupted sleep and circadian misalignment with weight gain, obesity, and adverse effects on individuals' metabolic health [35]. Therefore, as evidenced, adequate sleep at an appropriate time is essential for biological systems [36] and sports performance [28]. In this context, soccer is a social phenomenon that ranges from recreational to professional practice [37]. Likewise, there is evidence that soccer practice generates cardiovascular and metabolic benefits, helping to prevent diseases such as diabetes and hypertension [38]. Therefore, and considering that a large part of the population practices this sport, programs have been implemented to increase physical capacities [39], injury prevention [37] and good practices during rest periods [31]. Consequently, evaluating parameters such as sleep quality in athletes, specifically in Chilean professional soccer players, is a priority since good sleep hygiene ensures energy restoration, improves learning, memory, and cognition [1,6].

Despite the existing evidence and bearing in mind that many athletes present deficiencies in sleep quality and insomnia [40], studies in Chilean elite athletes are scarce [33]. In this context, only sleep quality, somnolence, and insomnia have been documented on Chilean elite Paralympic athletes [33]. Based on this background, and considering that sleep quality is a variable that conditions optimal sports performance [28], this study's main purpose was to determine sleep quality in Chilean professional soccer players. Secondary objectives were a) to quantify the number of sleep hours of Chilean professional soccer players; and b) to demonstrate, if there are, differences in sleep quality between different Chilean professional soccer clubs.

2. Materials and Methods

2.1. Research Design

Explanatory, cross-sectional research, with observable variables [41].

2.2. Participants

Ninety-four (94) Chilean male soccer players belonging to four professional clubs volunteered to participate in this study (n = 94; age = 25.6 $\pm$ 5.3). The evaluated clubs were Unión Española (n = 20), Deportes Antofagasta (n = 18), Palestino (n = 32), and Universidad de Chile (n = 24). The type of sampling was non-probabilistic by convenience. To be included in the study, participants had to be men, practice professional soccer for a minimum of four years, and train regularly between four to six times per week. The latter excluded participants with pathologies, musculoskeletal injuries, or a training frequency of fewer than four times a week. Before answering the questionnaires, and with all doubts resolved, the participants signed the informed consent form.

2.3. Procedure

After reading and signing the informed consent form, all participants were asked to answer the Spanish version [42] of the Pittsburgh Sleep Quality Index (PSQI) questionnaire [43]. Both the informed consent and the questionnaire were applied at the training site and before beginning any type of physical exercise.

2.4. Materials

PSQI. This questionnaire was created by Buysee et al. [44] and adapted to Spanish by Jiménez-Genchi et al. [42]. The instrument's objective is to self-assess the quality and subjective disturbance of sleep during a time interval of one month. Seven components assess this sleep quality: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, the use of sleep medications, and daytime dysfunction [42]. Although the PSQI does not inquire about the specificity of the medication used to fall asleep, it is crucial to record them as psychiatric [45] and non-psychiatric medication qualitatively [46]. The questionnaire has two parts; the first consists of four items (each item with an open question): 1. During the past month, when have you usually gone to bed at night? 2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night? 3. During the past month, when have you usually gotten up in the morning?, and 4. During the past month, how many hours of actual sleep did you get at night? The second part has six items with a total of 20 questions (each of these questions has four alternatives: 5. During the past month, how often have you had trouble sleeping because you... 6. During the past month, how would you rate your sleep quality overall? 7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep? 8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity? 9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done? and 10. Do you have a bed partner or roommate? The participant must only answer up to item nine of the questionnaire since item 10, which consists of five questions, must be answered by the "bed partner." Only the self-assessed questions are included in the scoring. The 19 self-assessed items are combined for the scores for the seven "components." Each of them has a range of 0–3 points. In all cases, a score of "0" indicates no difficulty, while a score of "3" indicates severe difficulty. The scores of the seven components are then summed to obtain an "overall" score, with a point range 0–21, "0" indicating no difficulty, and "21" indicating severe difficulty in all areas [42]. It should be noted that, for this study, a score $\leq$5.0 was considered good sleep quality [47].

2.5. Statistical Analysis

The results obtained in the PSQI questionnaire are presented with their mean data and respective standard deviation (SD). The data were subjected to the Kolmogorov and Smirnov normality test. Comparison of the variables between the different professional soccer clubs was performed through a one-factor ANOVA. We used the Student's t-test to compare participants who scored $\leq$5.0 with those who scored over 5 points on the Pittsburgh questionnaire on the sleep variables. On the other hand, the effect size was

calculated using Cohen's d-test. The latter analysis considers an insignificant (d < 0.2), small (d = 0.2–0.6), moderate (d = 0.6–1.2), large (d = 1.2–2.0), or very large (d > 2.0) effect. To relate the different variables of the questionnaire, we used the Pearson test. This correlation coefficient was interpreted through classifications described by Mukaka [48], in which 0.9–1.0 corresponds to a very high correlation; 0.7–0.9 high correlation; 0.7–0.5 moderate correlation; 0.3–0.5 low correlation; and 0.0–0.3 very low correlation. Statistical analysis was performed with SPSS software. The significance level for all data was $p < 0.05$.

3. Results

The analysis showed that the 94 Chilean male professional soccer players sleep an average of 7.27 ± 0.92 h per day. In addition, it was observed that 53% sleep less than 7 h a day. Simultaneously, 45% of the soccer players responded that they take between 20 and 40 min to fall asleep, 19% take between 50 and 120 min to fall asleep, and 36% manage to fall asleep in less than 10 min. A relevant data within this analysis was the bedtime of the soccer players (this time corresponds to the sum of the time to fall asleep and the effective sleep time), reaching 8.20 ± 1.00 h. At the end of the analysis, it was also possible to observe a significant difference in bedtime between the different soccer clubs evaluated ($p < 0.05$). The data and their significance are reported in Table 1.

Table 1. Time and effectiveness of sleep in Chilean male professional soccer players.

	Unión Española (*n* = 20)	**Deportes Antofagasta (*n* = 18)**	**Palestino (*n* = 32)**	**Universidad de Chile (*n* = 24)**	**All (*n* = 94)**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Time to fall asleep (min)	23.65 ± 26.0	32.55 ± 34.4	23.5 ± 21.2	29.75 ± 30.8	26.86 ± 26.9
Effective sleeping time (hours)	7.40 ± 1.41	7.58 ± 0.69	7.24 ± 0.74	7.00 ± 0.72	7.27 ± 0.92
Bedtime (hours) *	8.55 ± 1.13	8.66 ± 1.03	8.08 ± 0.79	7.72 ± 0.89	8.20 ± 1.00

SD: standard deviation; min: minutes; *: $p < 0.05$ between all groups.

According to the scores obtained in the PSQI questionnaire [42], it was observed that two of the seven components (component 2: sleep latency and component 5: sleep disturbances) had a value over one on a scale of 0–3. This observation was made in both analysis by clubs and as a whole. In the global analysis of the Pittsburgh Sleep Quality Index, it was observed a value of 4.75 ± 2.29 on the 0–21 scale and no significant differences between the clubs evaluated ($p > 0.05$). When comparing the soccer players who scored ≤5.0 with those who scored over five points on the Pittsburgh questionnaire in the sleep variables, we could observe significant differences in the time to fall asleep ($p < 0.001$) and in 6 of 7 components of the Pittsburgh questionnaire ($p < 0.05$). The data are reported in Tables 2 and 3.

Considering question 5 of the PSQI questionnaire, "During the past month, how often have you had trouble sleeping...?", it was observed that 62.8% of the participants reported difficulty falling asleep at some point during the last month. Simultaneously, 78.7% answered they woke up during the night or in the early morning, and 72.3% woke up to use the bathroom. The details of each of the responses to question 5 of the questionnaire are reported in Table 4.

Table 2. PSQI in Chilean male professional soccer players.

	Unión Española (n = 20)	Deportes Antofagasta (n = 18)	Palestino (n = 32)	Universidad de Chile (n = 24)	All (n = 94)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Subjective sleep quality	0.85 ± 0.67	0.88 ± 0.75	0.87 ± 0.55	1.08 ± 0.71	0.92 ± 0.66
Sleep latency	1.15 ± 0.87	1.16 ± 0.98	1.12 ± 0.97	1.41 ± 0.92	1.21 ± 0.93
Sleep duration	0.35 ± 0.67	0.11 ± 0.32	0.18 ± 0.39	0.37 ± 0.49	0.25 ± 0.48
Habitual sleep efficiency	0.65 ± 0.67	0.50 ± 0.61	0.34 ± 0.60	0.20 ± 0.41	0.40 ± 0.59
Sleep disturbances	1.10 ± 0.30	1.27 ± 0.46	1.18 ± 0.39	1.04 ± 0.46	1.14 ± 0.41
Use of sleeping medication	0.15 ± 0.36	0.05 ± 0.23	0.25 ± 0.56	0.29 ± 0.62	0.20 ± 0.49
Daytime disfunction	0.55 ± 0.60	0.44 ± 0.51	0.68 ± 0.53	0.66 ± 0.70	0.60 ± 0.59
Global score	4.80 ± 2.44	4.44 ± 2.30	4.65 ± 2.25	5.08 ± 2.32	4.75 ± 2.29

PSQI: Pittsburgh Sleep Quality Index; SD: Standard deviation.

Table 3. Comparison between male professional soccer players with scores ≤ 5.0 and above five on the Pittsburgh questionnaire.

	≤5.0 (n = 64)	>5.0 (n = 30)	F	t-test	Cohen's d
	Mean ± SD	Mean ± SD		p Value	ES
Time to fall asleep (min)	16.56 ± 14.66	48.83 ± 33.64	36.11	0.003	1.33
Effective sleeping time (hours)	7.53 ± 0.87	6.72 ± 0.78	0.11	0.734	0.98
Bedtime (hours) *	8.26 ± 1.02	8.07 ± 0.94	0.03	0.856	0.19
Subjective sleep quality	0.75 ± 0.53	1.30 ± 0.74	4.16	0.044	0.85
Sleep latency	0.85 ± 0.75	1.96 ± 0.85	0.26	0.605	1.38
Sleep duration	0.09 ± 0.29	0.60 ± 0.62	53.13	0.000	1.10
Habitual sleep efficiency	0.21 ± 0.41	0.80 ± 0.71	14.19	0.000	1.02
Sleep disturbances	1.06 ± 0.35	1.33 ± 0.47	20.82	0.000	0.65
Use of sleeping medication	0.07 ± 0.27	0.46 ± 0.73	60.23	0.000	0.77
Daytime disfunction	0.46 ± 0.56	0.90 ± 0.54	11.93	0.001	0.77
Global score	3.53 ± 1.30	7.36 ± 1.67	1.08	0.300	2.57

SD: standard deviation; min: minutes; ES: effect size; *: $p < 0.05$ between ≤5.0 and >5.0 group.

Table 4. Detail of responses to question 5 of the PSQI questionnaire.

Questions	Ranking			
	Has Not Occurred	<1 Time Per Week	1 to 2 Times Per Week	3 or More Times Per Week
Cannot get to sleep within 30 min (%)	37.2	33.0	25.5	4.3
Wake up in the middle of the night or early morning (%)	21.3	36.2	25.5	17.0
Have to get up to use the bathroom (%)	27.7	28.7	25.5	18.1
Cannot breathe comfortably (%)	93.6	2.1	4.3	0.0
Cough or snore loudly (%)	74.5	20.2	3.2	2.1
Feel too cold (%)	66.0	20.2	12.8	1.0
Feel too hot (%)	24.5	26.6	26.6	22.3
Had bad dreams (%)	67.0	25.5	7.5	0.0
Have pain (%)	71.3	20.2	6.4	2.1

PSQI: Pittsburgh Sleep Quality Index.

Pearson's test showed a high correlation between time to fall asleep and sleep latency (r = 0.79; $p < 0.01$), a high inverse correlation between participants self-reported effective sleep time and sleep duration (r = −0.72; $p < 0.01$), and a good inverse correlation between effective sleep time and overall PSQI score (r = −0.51; $p < 0.01$). The detail of all correlations is reported in Table 5.

Table 5. Correlations between time and effectiveness of sleep with the PSQI components in Chilean male professional soccer players.

		Time to Fall Asleep	Effective Sleeping Time	Bedtime	C1	C2	C3	C4	C5	C6	C7	Global
Time to fall asleep	r	1.00	−0.31 **	0.02	0.26 **	0.79 **	0.21*	0.46 **	0.01	0.33 **	0.07	0.66 **
	Sig. bil.		0.002	0.846	0.010	0.000	0.037	0.000	0.883	0.001	0.477	0.000
Effective sleeping time	r		1.00	0.67 **	−0.39 **	−0.27 **	−0.72 **	−0.33 **	−0.01	0.09	−0.29 **	−0.51 **
	Sig. bil.			0.000	0.000	0.008	0.000	0.001	0.912	0.347	0.004	0.000
Bedtime	r			1.00	−0.18	−0.01	−0.47 **	0.37 **	0.16	0.20 *	−0.18	−0.03
	Sig. bil.				0.080	0.884	0.000	0.000	0.124	0.047	0.071	0.731
C1	r				1.00	0.23 *	0.39 **	0.21 *	0.27 **	−0.05	0.22 *	0.62 **
	Sig. bil.					0.023	0.000	0.037	0.007	0.620	0.027	0.000
C2	r					1.00	0.21 *	0.30 **	0.05	0.25 *	0.05	0.67 **
	Sig. bil.						0.042	0.003	0.592	0.014	0.593	0.000
C3	r						1.00	0.31 **	0.02	0.00	0.16	0.54 **
	Sig. bil.							0.002	0.827	0.950	0.108	0.000
C4	r							1.00	0.27 **	0.19	0.06	0.62 **
	Sig. bil.								0.007	0.062	0.565	0.000
C5	r								1.00	0.00	0.19	0.41 **
	Sig. bil.									0.932	0.055	0.000
C6	r									1.00	0.05	0.37 **
	Sig. bil.										0.606	0.000
C7	r										1.00	0.44 **
	Sig. bil.											0.000
Global	r											1.00
	Sig. bil.											

PSQI: Pittsburgh Sleep Quality Index; C1: subjective sleep quality; C2: sleep latency; C3: sleep duration; C4: sleep efficiency; C5: sleep disturbances; C6: use of sleeping medication; C7: daytime disfunction; min: minutes; r: Pearson's correlation index; Sig. bil: significance (bilateral); *: alpha < 0.05 (bilateral); **: alfa < 0.01 (bilateral).

4. Discussion

Concerning the main objective of the study, to determine sleep quality in Chilean male professional soccer players, the Pittsburgh questionnaire analysis [42] yielded a value of 4.75 ± 2.29; this value is considered a good sleep quality [47]. In this sense, Swinbourne et al. [49] evaluated sleep quality in professional athletes; these researchers reported a 5.9 ± 2.6 in the Pittsburgh questionnaire and concluded that more than 50% of the evaluated athletes had poor sleep quality (≥5.0 points). In parallel, Khalladi et al. [50] evaluated the sleep characteristics of professional soccer players in the Qatar Stars League. The researchers reported a 68.5% prevalence of players with poor sleep quality (≥5.0 points), concluding that professional soccer players should be more aware of the importance of good sleep quality. It appears that the existing evidence on sleep quality in performance athletes shows worrying indicators [49], even more so in professional soccer players [50]. However, both the overall analysis and the present study showed good sleep quality in Chilean male professional soccer players when comparing the different professional soccer clubs (4.75 ± 2.29). In fact, there were no significant differences between the clubs evaluated ($p > 0.05$), and only one club exceeded five points in the Pittsburgh questionnaire [42].

A vital background to analyze is the hours of sleep reported by the present evaluated clubs (7.27 ± 0.92 h); this period is within the National Sleep Foundation's recommendations for young people (7–9 h) [10]. Apparently, without considering sleep quality, evidence shows that the amount of sleep hours reported by professional athletes is within the recommendations described above [31,49,50]. An example of this is the data reported by Swinbourne et al. [49]; the researchers evaluated the hours of sleep of 175 professional athletes from various disciplines, reporting an average of 7.9 ± 1.3 h of sleep per day. Likewise, Khalladi et al. [50] reported an average value of over 7.5 h of sleep in professional soccer players, while Caia et al. [31] reported that professional rugby players sleep an average of 7.28 ± 0.8 h per day. However, although evidence shows that elite athletes sleep the recommended number of hours [10], it has also been documented that athletes have sleep problems, identifying three factors that could alter sleep: (a) training, (b) travel, and (c) competition [14]. Consequently, correct sleep hygiene could guarantee positive changes in sleep behavior and a more restful rest [31], which could impact better performance in training and/or competition.

In the present study, when comparing the number of hours of sleep between male professional soccer players who scored ≤ 5.0 to those who scored over five points on the Pittsburgh questionnaire [42], there were no significant differences between these two groups of soccer players ($p > 0.05$). However, evidence shows a significant difference—between those who score above and below five points—concerning the number of sleeping hours [50]. Despite this, there is still a lack of evidence to ensure that a score above five is associated with sleep outside the National Sleep Foundation's recommendations (7–9 h) [10]. When, the same comparison was made in the time to fall asleep, a significant difference was found between scores ≤ 5.0 and above 5 ($p < 0.001$). In this sense, Gupta et al. [14] developed a study that aimed to profile the objective and experienced sleep characteristics among elite athletes. They concluded that cognitive arousal before sleep appears as one of the mechanisms responsible for a longer time to fall asleep [14]; therefore, proper sleep hygiene education may lead to positive sleep behavior changes, which is likely to be beneficial in achieving peak athletic performance [31]. In the present study, regarding the overall PSQI score [42] and the comparison between soccer players with scores $\leq$5.0 and above five, no significant differences were found between the two groups ($p > 0.05$). However, a previous study showed significant differences in this index when purchasing participants with scores ≤ 5.0 and over five [50]. Despite this evidence, finding significant differences in these variables does not ensure causality since the results may be conditioned by sample size, group distribution, range, mean values, and standard deviations.

In parallel, a good inverse correlation between effective sleep time and the overall PSQI score was evident ($r = -0.51$; $p < 0.01$). However, due to the limited evidence relating sleep quality to athletic performance [28], it would be risky to attribute poor athletic performance to sleep deprivation and poor sleep quality. In this regard, Oliver et al. [51] evaluated whether a night of sleep deprivation impaired performance in a treadmill test. The researchers reported decreased performance with limited effect on running pace, and on cardiorespiratory and thermoregulatory function, but no effect on exercise perception. Similarly, Poussel et al. [52] evaluated the relationship between sleep strategies and performance during the 2013 North-Face Ultra-Trail du Mont-Blanc. At the end of the investigation, it was reported that runners who adopted a sleep management strategy based on more sleep time before the race completed the race faster ($p = 0.02$). Furthermore, the researchers reported that most finishers seemed to be aware of the importance of developing sleep management strategies. Contrarily, Blumert et al. [53] compared the effects of 24 h of sleep deprivation on weightlifting performance, concluding that 24 h of sleep deprivation does not affect weightlifting performance. Based on the evidence, when analyzing the effect of sleep deprivation on sports performance, there is a marked difference between strength and endurance sports. Apparently, in the latter sports discipline, sleep deprivation significantly affects sports performance [51,52]. A separate analysis is needed for team sports since most research is focused on the description of

sleep quality of athletes [31,49,50] and not on an association between good sleep quality and sports performance [25]. An example of this is the study by Mah et al. [25] who evaluated the effect of sleep length on reaction time, mood, and daytime sleepiness in college basketball players, concluding that optimal sleep is likely to be beneficial for peak athletic performance. Despite this, it is risky to claim that good sleep quality guarantees an athletic outcome in team sports.

Another critical component to consider is the high percentage of male soccer players who reported difficulty falling asleep at some point during the last month (>63%). This difficulty in falling asleep may be directly related to the sleep-wake cycle [54]; in this sense, it has been shown that an instantaneous interruption of sleep as a result of a response to a biological or physiological signal [55] can affect the circadian rhythm of athletes [56]. The latter corresponds to daily cycles that regulate the physiological functions of the organism [57]. Its alteration may contribute to an increased risk of diseases [58] and a decrease in sports performance [56]. Different studies have shown that circadian rhythms cause variations at the hormonal level, in gene expression and body temperature [57,59], directly influencing different components relevant to sports performance such as muscular strength [60], flexibility [59], aerobic endurance [61], and anaerobic power [62]. The sleep-wake cycle is one of the most relevant circadian rhythms for athletes [54], indicating daily rest time [57]. This cycle can be negatively altered due to national or international travel [63], generating a decrease in sports performance due to fatigue and/or jet lag [64]. On the other hand, a score over five in the PSQI could indicate an altered circadian cycle [11]. Since the alteration of the circadian cycle could affect athletes' physical recovery [56], all the evaluated players should pay attention to it (especially players from Universidad de Chile, who as a whole obtained a score over five in the Pittsburgh questionnaire [42]). This alteration may develop health problems [58] and a decrease in sports performance [14,56].

There are several strategies to improve sleep quality of athletes. As a first measure is the use of electronic devices. An example of these are smartwatches; these devices allow monitoring and evaluating sleep quality efficiently and reliably [65,66]. Another strategy adopted by some athletes to improve sleep quality, and thus sports performance, is the increase of sleep time some nights before the competition [52]. Moreover, in the case of experiencing an acute period of sleep loss, it is suggested to focus more on psychological aspects (motivation) than on the sport's physiology [53]. Finally, the data obtained reinforces the need to educate professional soccer players and the multidisciplinary team on correct sleep hygiene [29–31].

Limitations

The results of our research show good sleep quality in Chilean male professional soccer players. However, the study did not have a control group to contrast the results with. There was only a qualitative comparison to the recommended values for good sleep quality and its analysis.

As a suggestion for future research and considering the specificity of the group evaluated, we recommend including stress and anxiety evaluations since these factors are mentioned as critical influencers on athletes' sleep quality and performance.

5. Conclusions

According to the results obtained, Chilean male professional soccer players have a good sleep quality. However, the high values of "sleep latency" and "sleep disturbances" are indicators that should be worked on by the multidisciplinary team of each professional club, generating strategies to improve sleep hygiene, encouraging good sleep, and efficient ways of falling asleep.

6. Practical Applications

Multidisciplinary teams working with elite athletes must cover all variables associated with sports performance. For this reason, assessing and improving sleep quality is

fundamental to ensure proper recovery between training sessions. Consequently, an easy way to monitor sleep quality is through the PSQI. However, to obtain high reliability rates in the application of this test, athletes must be familiarized with it. In this sense, and to increase the reliability of the test, we recommend that multidisciplinary teams regularly apply it to athletes. Finally, in assessing poor sleep quality, we suggest applying sleep hygiene programs to athletes, including a personalized study of the circadian cycle.

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